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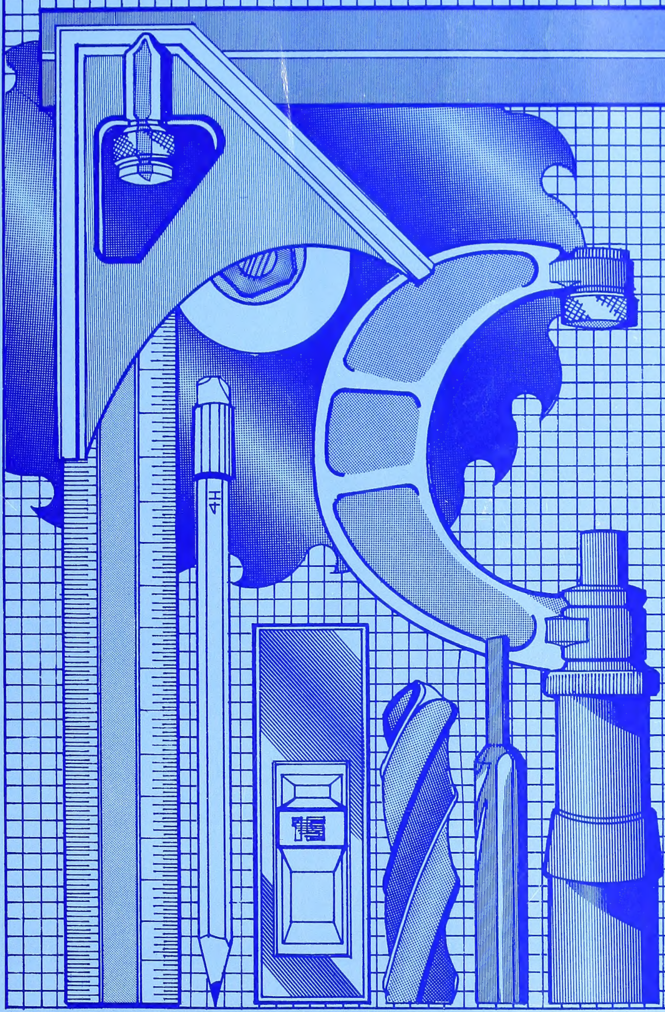

FARM WORKSHOPS

Alberta
AGRICULTURE
ENGINEERING

Farm Workshops

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FARM WORKSHOPS

Prepared by the Engineering Branch
of Alberta Agriculture

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Alberta AGRICULTURE
ENGINEERING

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APPENDIX 60

"You say you lost your husband in here?"

chapter 1. INTRODUCTION

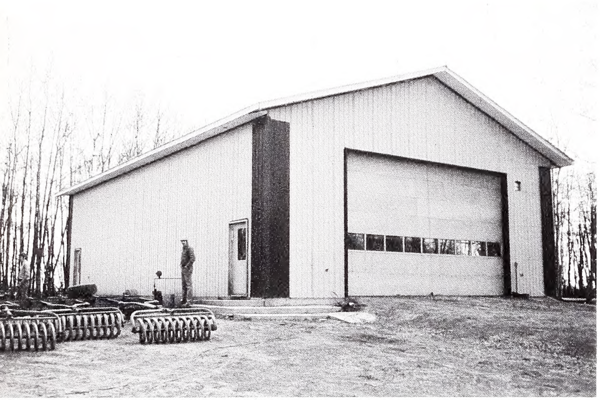
Most farms have a building which is called the farm workshop, but how many of them resemble hurricane relief areas? The answer to that is too many. Work benches that are piled a foot deep, engine stands that have to be dug out of a corner, and tools that never stay on a tool rack are all symptoms of a workshop that isn't working. There is no good reason why workshops so often end up this way, but there are many causes:

- Leaving a job half done for months on end, or taking things apart but neglecting to put them together again.
- Promising to clean up . . . later.
- One or more members of the family who contribute more than their fair share of untidiness.

These are all problems which require will power and good work habits to fix. Although this book can't help anyone become tidier, it can address the other major reason for disorganized workshops; **LACK OF PLANNING!** There are many things to consider when planning a farmshop. This publication discusses many of the details which will make a workshop safe, organized and functional. Keeping it tidy is up to you.

Topics included in this publication are:

- Planning the layout of a shop to save steps and promote organized work habits
- Sizing a farm shop to the needs of the farm and the capabilites of the farmer
- Selecting the best type of foundation for your building
- Choosing the optimum amount of insulation for a work shop
- Recommended lighting levels of work spaces
- Sizing and selecting heating systems
- Ventilation requirements for farm workshops
- Determining electrical needs for a shop
- Selecting workshop equipment.



igure 1a. *A well drained site is essential for farm shops.*

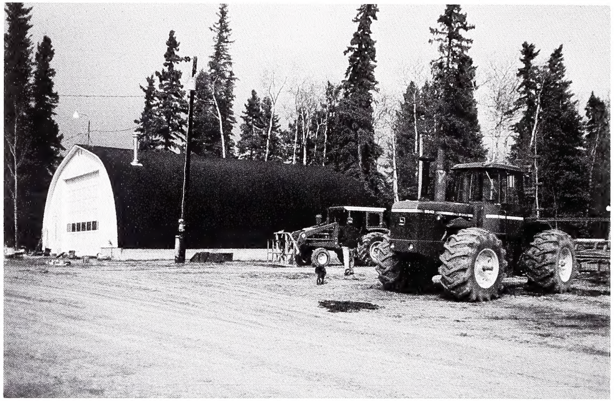
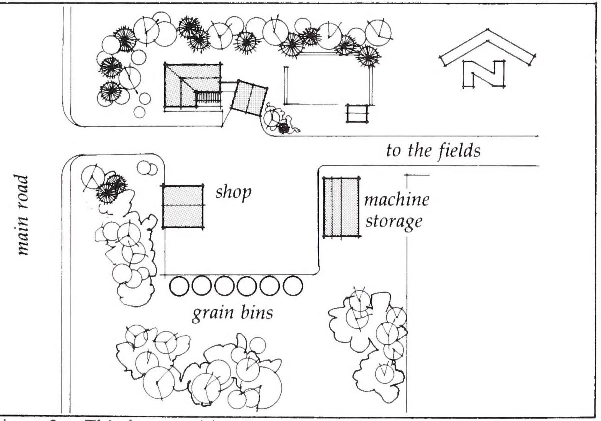


Figure 1b. Leave plenty of space around the shop for maneuvering large equipment.



igure 2a. This farmstead has lots of maneuvering room around the workshop.

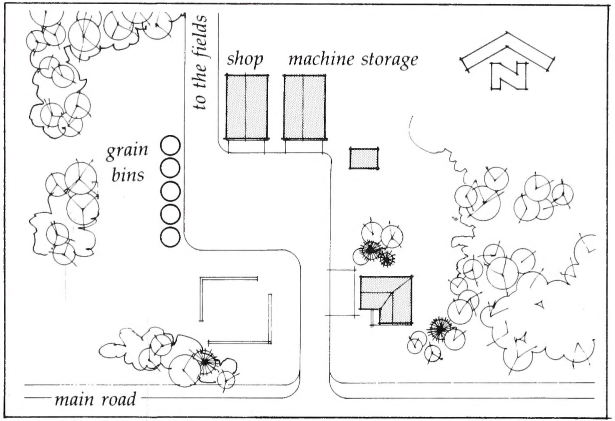


Figure 2b. Having the shop and machine storage side by side is convenient but will increase fire insurance premiums.

chapter 2. SITE SELECTION

The location of the farm shop and its orientation are very important. Although each farm layout will be different consider the following guidelines before laying out the farm shop.

- Locate the workshop on a well drained site so that water from spring runoff or heavy rainfalls does not accumulate near it.

- Locate the shop within 60 metres (200 ft) of the house for convenience

- When a workshop is added to an existing farmstead there may be restrictions on the location. If this is the case, the single most important factor is to allow sufficient space in front of the shop for maneuvering equipment. A small workshop should have a clear space of 20 metres (65 ft) in front for maneuvering equipment. For a large shop try to leave 15 metres (50 ft) around the side and 45 metres (150 ft) in front of the main door.

- Any building with welding equipment, such as a farm shop, is considered a high fire risk and will be assessed accordingly by insurance companies. It is important to remember that any building within 15 metres (50 ft) of the shop may also be assessed at the same high fire risk premiums. For this reason it is desirable to have a separate machinery storage located at least 15 metres (50 ft) away. Provide direct access from the main door of the machinery storage building to the main door of the worksho

- A shelter belt is desirable to reduce the effects of wind and to control the location of snow drifts. Face large doors away from prevailing winds. Since much of the repair work is done near or just outside the front door, strong winds can make this area unpleasant. Blowing dirt can infiltrate every corner of a workshop.

- Doors on the south or east side are preferred but this may not always be possible. Avoid placing doors on the north side as ice accumulation can cause problems in the winter.

A most important consideration is allowance for future expansion or modifications. If possible, plan future expansion now, or if in doubt leave extra space around the shop.

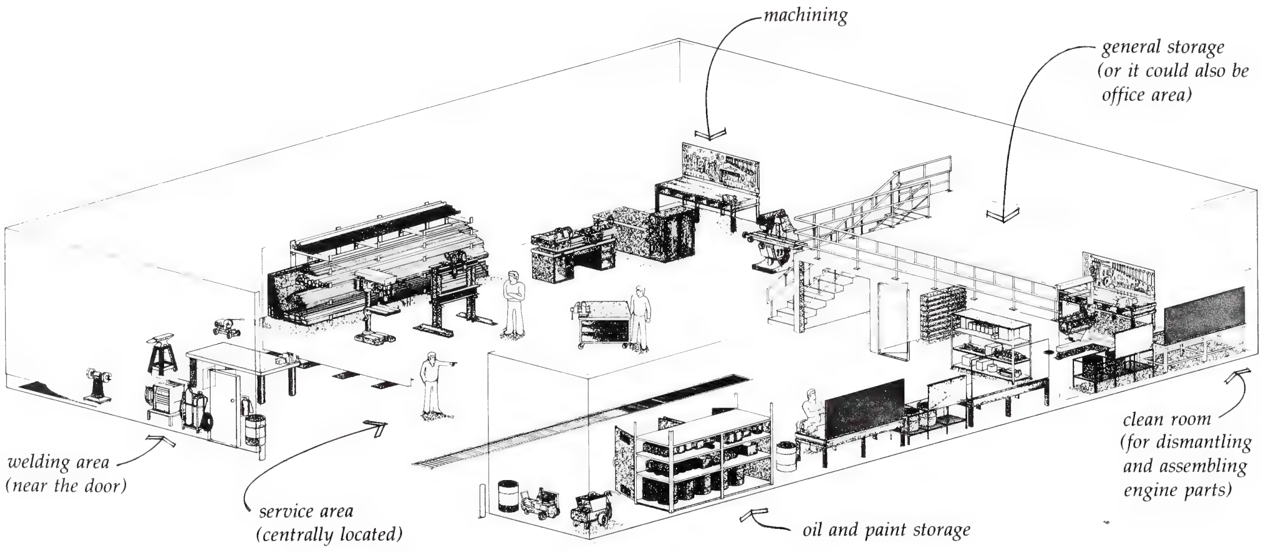


Figure 3. The deluxe workshop layout.

chapter 3. WORKSHOP LAYOUT

Planning the farm workshop will depend on the needs and skills of the farmer/operator, however there are principles of workshop design which help in planning the best possible layout for a shop of any size. These principles are based on identifying the different work areas within the shop. Work areas may overlap, for example, the welding area and the service area usually overlap. Others have distinct borders such as permanent or portable walls, for example there should be a barrier between the machining area and the welding area in order to keep welding grit from comtaminating engine parts.

A workshop may or may not include all of the work areas, depending on its purpose. For example, it is not likely that a machinery repair workshop would include woodworking. Planning considerations for each of the following work areas is discussed in this chapter.

- service area
- welding area
- machining area
- clean area
- office area
- general storage area
- storage area
- woodworking area

Figure 4. A well planned workshop is easier to keep tidy.

chapter 3 WORKSHOP LAYOUT

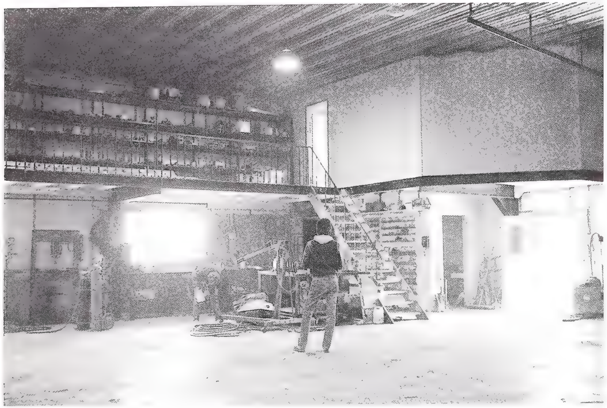


Figure 5. Make sure the service area is large enough . . .

Figure 6. . . . To service whatever equipment you may own.

SERVICE AREA

Equipment is serviced, adjusted, dismantled and even washed in this area, trucks and tractors can also be stored here during the winter. The service area is centrally located and shared with other areas. It is adjacent to the main door, the welding area and the clean area. Direct access to oil and grease storage is advantageous.

Equipment and Special Features

- stationary work bench
- portable work bench
- portable crane and floor jacks
- air compressor
- high pressure washer
- cleaning tank
- scaffold stairway for working on large equipment
- A floor drain is necessary to deal with the mud, ice and snow tracked in on equipment.
- A service pit is not recommended since experience shows that it tends to collect rubbish. It can also catch fire if fuel, oil or heavy vapours accumulate in it. It is very difficult to make a rapid exit from a pit in the event of an emergency and it is definitely not a substitute for a vehicle lift because of poor access to the shop facilities.

Storage

Provide a hanging board near the main door for chains, load tie-downs, extension cords and shovels.

WELDING AREA

Welding, cutting, shaping, and grinding of metal are all done in the welding area. This area is located adjacent to the machining area, the service area and it is also next to the main door so that welding can be done on equipment parked outside. Since the welding area is a high fire-risk area enclosing it with fireproof curtains hung from the ceiling or movable screens will help to confine sparks and grit.

Equipment

- electric welder
- acetylene welder
- anvil

- welding table with vice
- grinder
- abrasive cutter and/or power hacksaw
- hydraulic press (may also be located in the machining area)
- a water tank for cooling and heat treating metal.

Storage
- an enclosed cabinet to keep welding rods clean and dry
- a tool board for special tools and accessories such as circle cutters, protractor guide, dividers and compasses
- a storage rack for steel located nearby
- a rack or drawer under the welding table for an angle grinder, electric drill, hammers, C-clamps and vise grips.

MACHINING AREA

Turning, milling, drilling and hydraulic press work are done here. The machining area can be located off in a corner, however the drill press and hydraulic press should be readily accessible to the welding area.

Equipment
- a worktable against a wall as well as one adjacent to the lathe and milling machine are desirable
- drill press
- tool grinder
- hydraulic press
- lathe
- milling machine.

Storage
- store accessories, adapters and jigs for each machine within easy reach
- an enclosed cabinet for cutting tools and measuring instruments
- a small rack to store special metals, such as brass and aluminum for machining
- a small cabinet or rack beside the drill press can store the drill press vise, C-clamps and other jigs or fixtures.

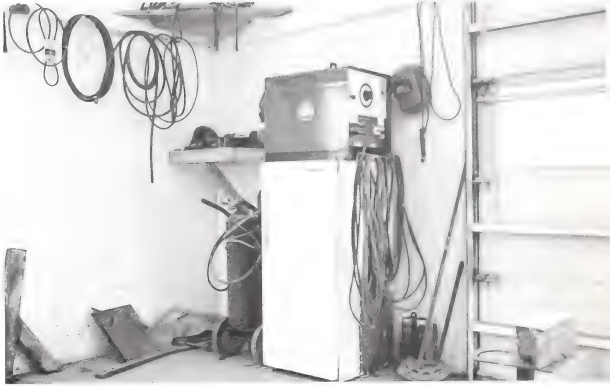


Figure 7. This compact welding area has many good features: It's near the main door; the old refrigerator makes an excellent storage for welding rods; the acetylene welder is tucked out of the way; and all cables, helmet and accessories are neatly stored.

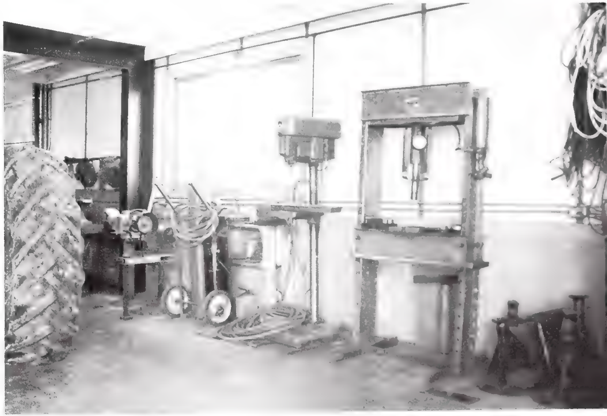
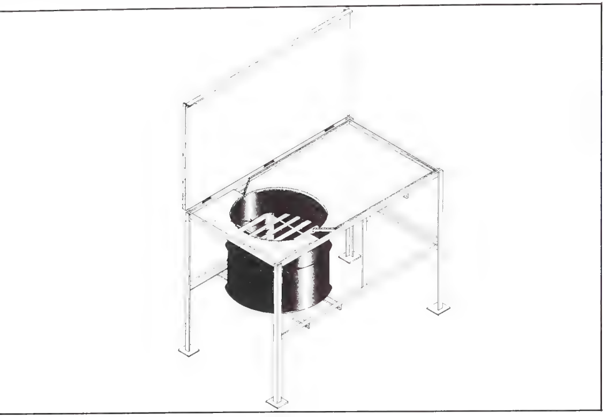
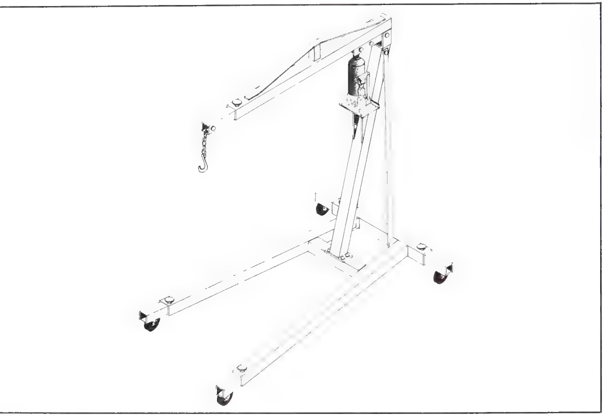


Figure 8. To save space this machining equipment is pushed against the wall when not in use.



igure 9. *A metal topped cleaning table.*



igure 10. *A chain hoist.*

CLEAN AREA

The clean area is used for overhauling, rebuilding and major repairs. It should be located away from the welding area but adjacent to the service area where engines and other components will be removed from equipment. Although there may be oil on the floor during an engine overhaul it is important to keep this area neat and grit free.

Equipment

- a work table
- a solvent cleaning tank with a lid is very useful in this area
- a metal topped table which drains to an oil bucket is useful for disassembling oil pumps.
- a portable engine stand may also be included
- a paper towel dispenser.

Storage

- a tool board
- enclosed cabinets for electrical terminals, wire, O-rings, brass fittings
- a set of bins for hydraulic fittings, pipe fittings, fine thread bolts
- shelves for replacement parts
- shelves for storage of items awaiting new parts.

OFFICE AREA

The office is used to store equipment manuals and log books and may have a desk and telephone. It may also be used for planning projects or simply as a quiet clean place to have a cup of coffee. The office is also the logical place to store a first aid kit.

The location is not critical but should be away from the more active areas of the shop. For small shops the office can be the end section of a work bench. For larger shops the office should be totally enclosed for cleanliness and quietness. This is one area where a window is a definite asset. It makes the office a more pleasant place to work and allows a view of farm activities. Locate the window to face the yard and home driveway.

Equipment and Storage
- a desk or table and chairs
- a cabinet for storing small items would be desirable
- a bookshelf for equipment manuals
- a filing cabinet for log books
- some people would consider a coffee pot a necessity.

GENERAL STORAGE AREA

The general storage area is only for storage of spare parts and equipment, it is not a work area. Location is not critical but it should be accessible from the service area. It should be possible to maneuver long objects into and out of the storage area. A partial second floor with a stairway is often used for storage.

Equipment
- a good quality ladder
- a hook-stick to retrieve belts hung on the wall.

Storage
- shelves to store large objects
- rack with pigeon holes of various sizes to store smaller parts or a quantity of the same part
- bins, similar to the bolt bin, for storing small parts
- rack to store long shafts, etc.

OIL STORAGE AREA

Oil, grease, filters, and paint are best stored in an enclosed room to contain fires and maintain cleanliness. Pesticides should not be stored with oil and grease. If possible store agricultural chemicals, like pesticides, in another building.

The oil storage area is located away from the welding area but adjacent to the service area so that the oil and grease are accessible to machines being serviced. If this area is close to the main door, oil and grease can be easily obtained for equipment being serviced on the apron. This area should be 3 by 4 metres minimum (10 ft by 12 ft), and be able to accommodate 45 gallon drums.

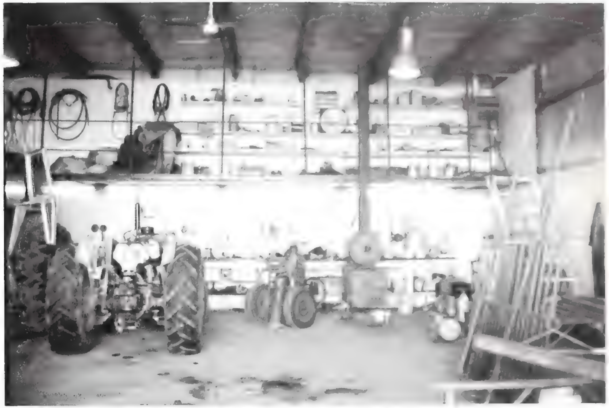


Figure 11. A partial second floor for general storage makes use of the building height over the work bench area.

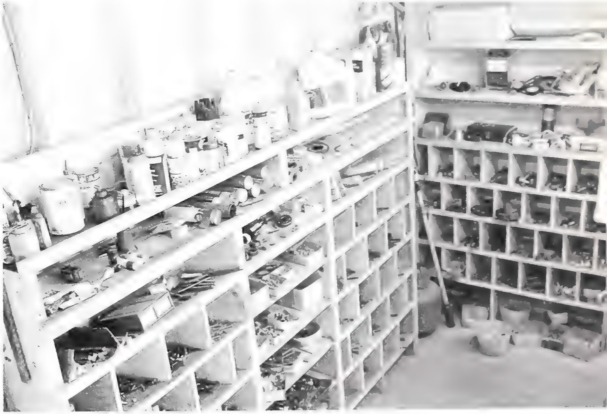


Figure 12. A well organized parts storage room is recommended for large workshops.

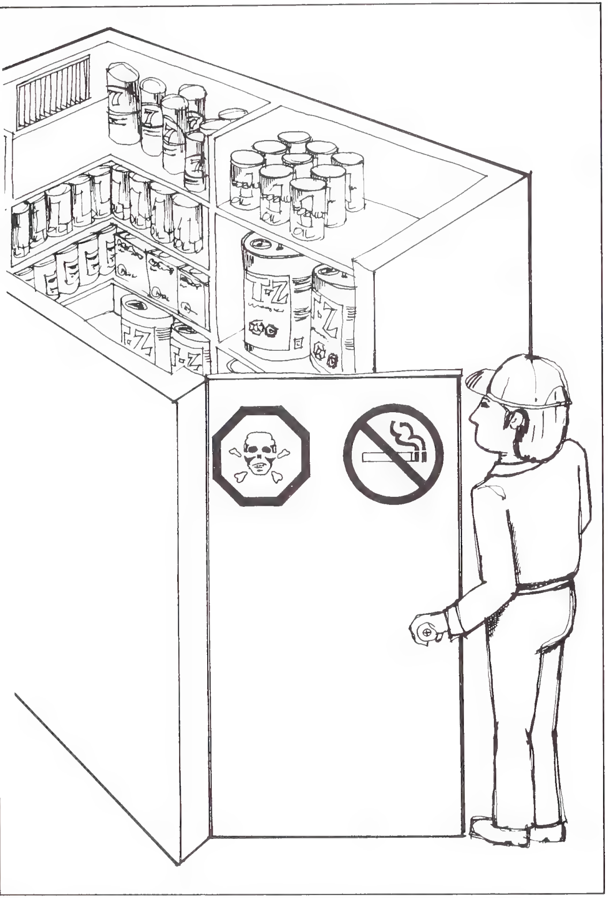


Figure 13. An oil or paint storage area should be ventilated and posted with warning signs.

Equipment

A device for moving barrels of oil such as a 2-wheel dolly or 3-wheel barrel carrier is very practical. Since larger engines require large amounts of oil to refill the crankcase, the barrel of oil can be equipped with a pump and hose and brought to the engine for refilling.

Storage

- a metal cabinet for paint
- metal garbage barrel with lid
- shelves and floor space for containers.

WOODWORKING AREA

Dust from sanding and sawing can cause problems in other areas of a machine work shop including contamination of oil or oily machine parts. Because a woodworking shop is not compatible with a machine workshop it is best to locate woodworking in another building, however, this is not always practical. If the woodworking shop is combined with the farm workshop, it must be completely enclosed to confine the dust. Use dust collectors on equipment and an exhaust fan to improve air quality.

WORKSHOP LAYOUT

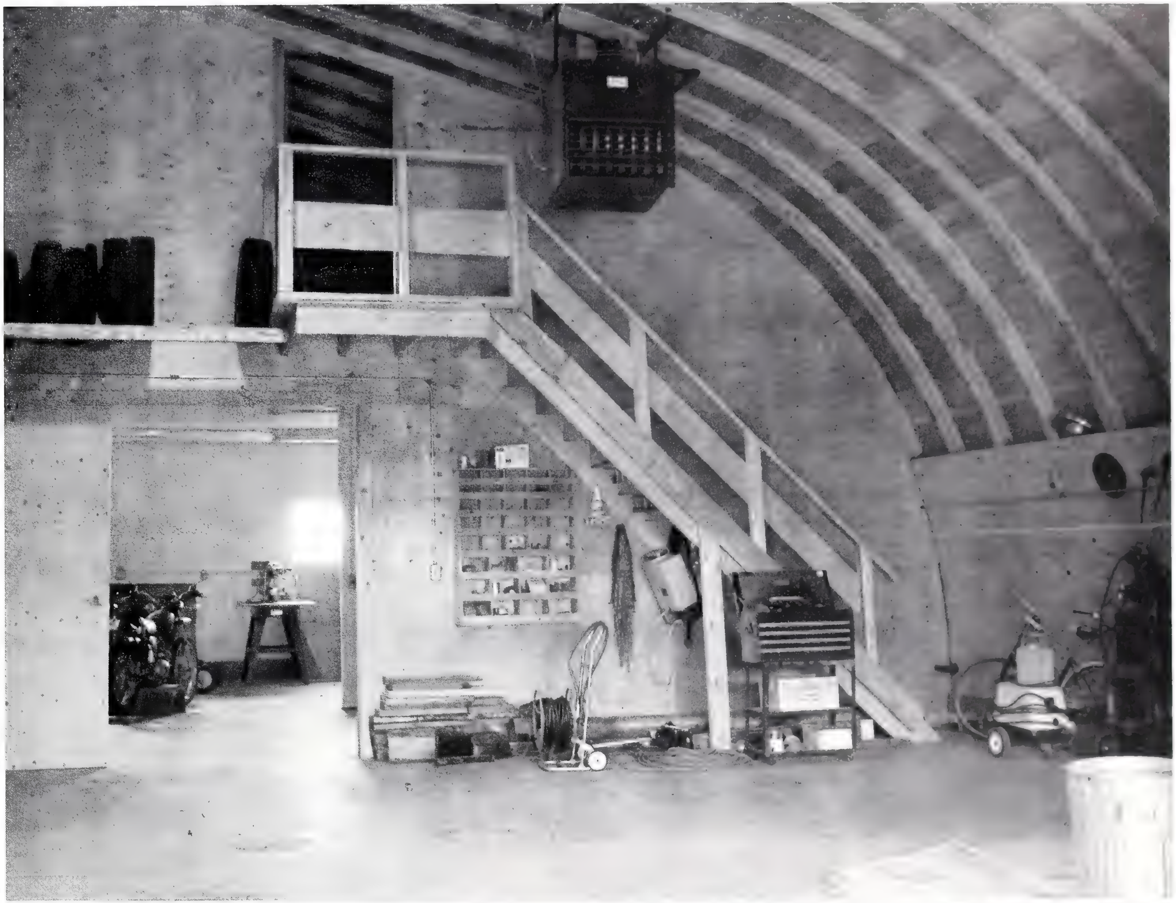
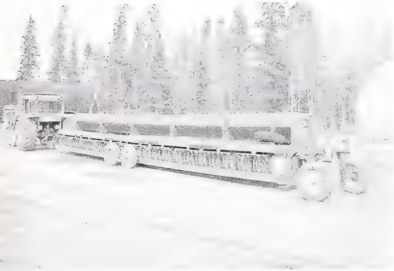


Figure 14. This well planned out farm shop makes excellent use of the available space. The woodworking area (through the doors at the back of the shop) is completely partitioned off from the rest of the shop but it is accessible through the large sliding door (which is half open in this photo). A partial second floor has been constructed over the woodworking area where the extra building height is not necessary.



igure 15. *The building must be long enough to ontain the largest piece of equipment requiring xtensive work.*

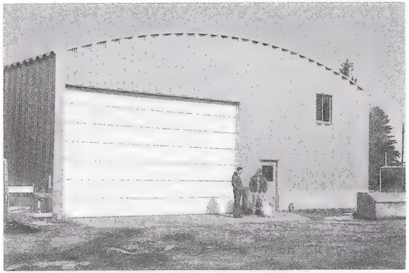


Figure 16. An off centred main door makes more efficient use of interior space in buildings 12 to 15 metres (40 or 50 ft) wide.

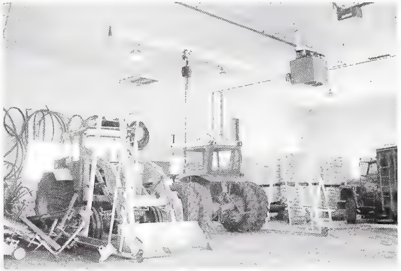


Figure 17. Unit heaters effectively lower the height of this building from 5 metres to 4 metres (16 ft to 13 ft). Notice the A frame hoist can graze the heater.

TABLE 1. RECOMMENDED DIMENSIONS FOR FARM SHOPS

ype of arm Shop	Size	Ceiling Height	Repair Area	Welding Area	Office Area	Work Bench Length
inimum Service	7 m x 9 m (24 ft x 30 ft)	3.6 m (12 ft)	3.6 m x 4.8 m (12 ft x 16 ft)	portable welder	at the bench	2.4 m (8 ft)
verage Farm	9 m x 12 m (30 ft x 40 ft)	4.2 m (14 ft)	4.6 m x 6.0 m (15 ft x 20 ft)	2.4 m x 3.0 m (8 ft x 10 ft)	at the bench	3.6 m (12 ft)
arge Farm	12 m x 15 m (40 ft x 50 ft)	4.8 m (16 ft)	9 m x 12 m (30 ft x 40 ft)	3.0 m x 4.6 m (10 ft x 15 ft)	2.4 m x 2.4 m (8 ft x 8 ft)	4.8 m (16 ft)
orporation Farm	15 m x 22 m (50 ft x 75 ft)	4.8 m (16 ft)	9 m x 18 m (30 ft x 60 ft)	4.2 m x 6.0 m (14 ft x 20 ft)	3.6 m x 3.6 m (12 ft x 12 ft) enclosed	7.2 m (24 ft)

chapter 4

THE BUILDING

SIZING THE FARM WORKSHOP

There are no exact rules for selecting the size of a farm workshop. The size depends on your present needs and the future needs of your farm and your family. It is usually difficult to enlarge a shop so plan carefully before you build.

Building Length

The shop length depends on

- the length of the equipment brought into the shop
- the amount of clearance required for maneuvering hoists and other equipment around the machine being serviced
- the location of the work bench, whether it is located at the back wall or along the side wall.

The minimum practical length for a small farm workshop is 7 metres (24 ft). Servicing a combine requires a shop at least 12 metres (40 ft) in length. If the work bench is on the end wall (often the case in narrow shops) add an extra 3 metres (10 ft) to the building length to accommodate a work bench, portable tool trolleys and working space.

Building Width

To give yourself enough space to work in, the minimum building width should be twice the width of the main door. This provides wind protection for sliding and bifold doors as well as elbow room on all sides of the largest machine that can be squeezed through the main door.

The width of a farm shop affects workshop layout. For shops 12 to 15 metres (40 to 50 ft) wide, it is best to have the main work bench along one side wall, with iron storage and parts bins arranged on the other side wall. This layout is most efficient for servicing and bench work. Narrower shops locate the work bench area at the back wall.

Building Height

The height of the shop and the size of the main door depend on present (and future) machinery sizes. On a typical grain farm a 4.8 m (16 ft) ceiling height is recommended. Ceilings 4.2 m (14 ft) high have been common in the past but present machinery trends, particularly on the prairies, indicate that a 4.8 m (16 ft) ceiling will be more practical for medium to large sized shops. A 4.8 m (16 ft) ceiling will give you some clearance above a large combine or grain truck box. Don't forget that ceiling fans and unit heaters reduce clearance.

chapter 4 THE BUILDING

igure 18. A studwall truss rafter workshop with a deluxe farm office ttached to the side.

igure 19. A wooden arch rafter shop and machine storage.

SELECTING THE BUILDING TYPE

Farm workshops can be any of the common building types such as stud frame, arch rafter, post frame, rigid frame, steel frame, metal quonset.

Stud-wall truss-rafter buildings are practical for any size of farm shop. Farmers and contractors are very familiar with the design and construction of this type of building. They are fairly easy to build and certainly the easiest building type to insulate and finish.

Wooden arch rafter buildings make very practical, economical farm shops. Arch rafter building packages can be bought and easily erected by the farmer. They are easy to insulate. Finishing requires more work than a straight wall building since cupboards, tool racks and benches have to be adapted to the arch shape.

Wooden post frame buildings are commonly used for machine storages, but they also make an inexpensive farm shop. Use square posts to make insulating and finishing practical. Because concrete forming is not required for the foundation, and trusses can be spaced 1.2 metres (4 ft) or even 2.4 metres (8 ft) apart, the building shell can be erected rapidly.

Rigid wood frame buildings are easily constructed on the farm, however building widths are usually limited to 10.8 m (36 ft) maximum.

Steel frame buildings are available in any size, and are usually designed with steel ribs spaced 4.8 to 6.0 metres (16 to 20 ft) apart. Because the building load is concentrated on widely spaced ribs, deep pile foundations are usually recommended. Steel frame buildings should be insulated during construction with the insulation package recommended by the building supplier. It is usually difficult and costly to insulate them properly at a later date. Side wall doors present no problem for steel frame buildings with widely spaced ribs.

Steel quonset buildings are a versatile, low cost utility structure. They are best used as a multi-purpose building, for machine storage, temporary grain storage, and as a part-time shop. Steel quonsets are difficult to insulate properly. Spray-on foam is commonly used but it must be covered with a fire resistant lining.

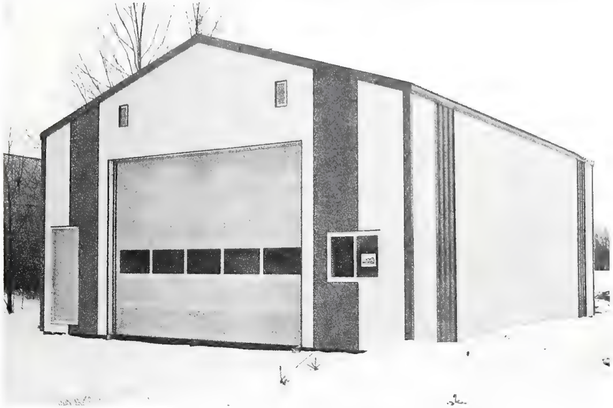


Figure 20. Pole frame shops can look as nice as the stud wall buildings and extra height is no problem.

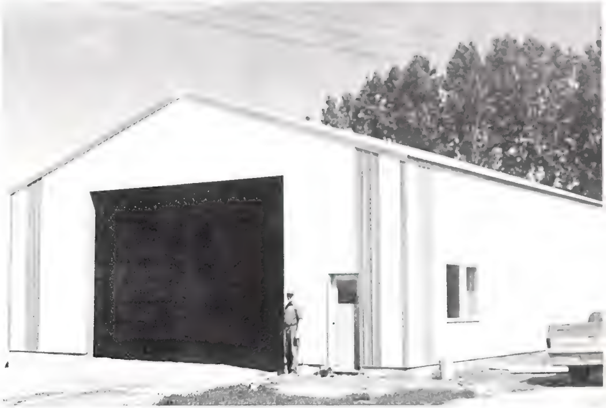


Figure 21. Rigid frame workshop by Dandi Buildings Ltd., Figure 25 on the next page is also a rigid frame workshop.

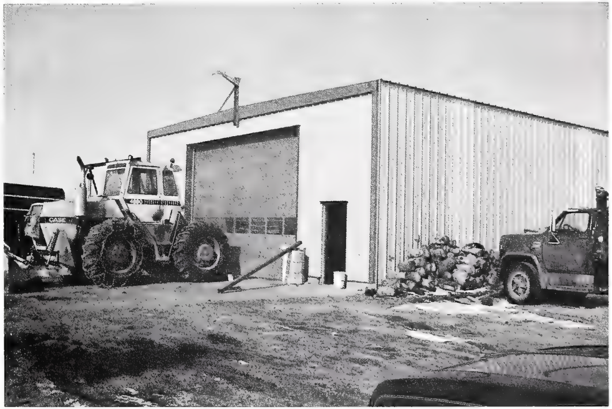


Figure 22. Steel frame workshop.

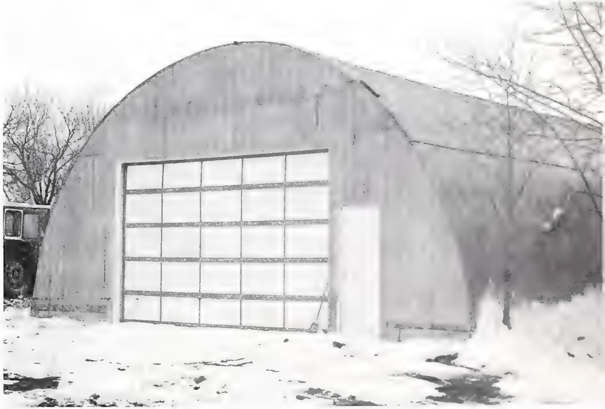
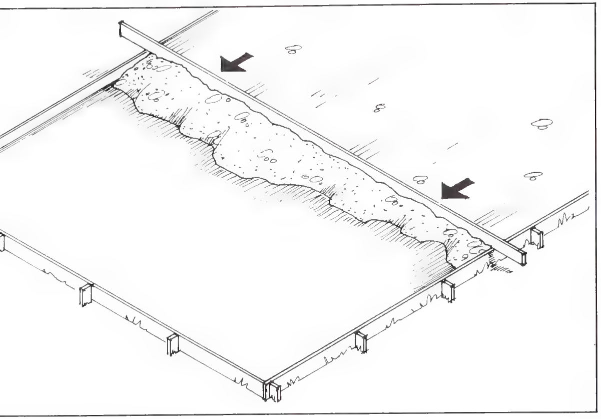


Figure 23. Steel quonsets are generally used as an all purpose building.



igure 24a. Striking off.

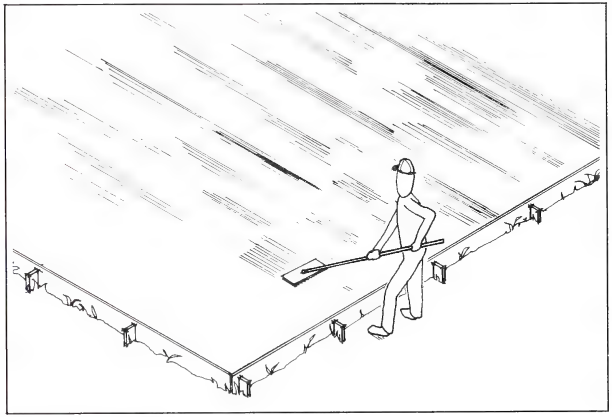
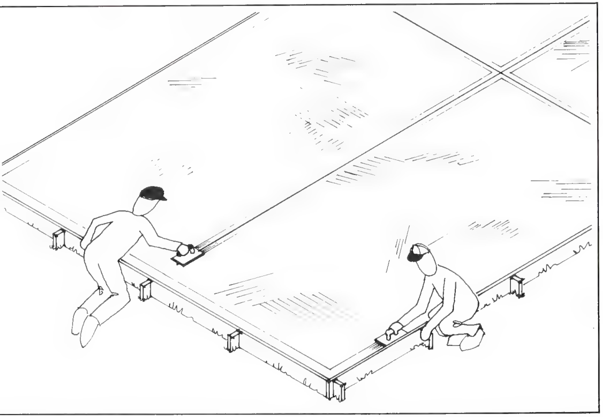


Figure 24b. Floating.



igure 24c. Jointing and edging help to control cracking in floor slabs.

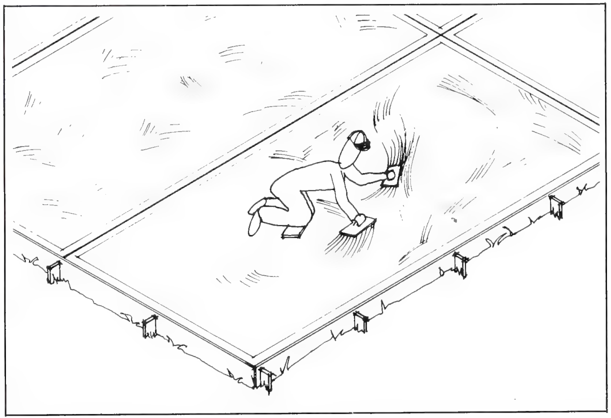


Figure 24d. Adequate trowelling is the best way to reduce the problem of dusty concrete floors.

chapter 5. FOUNDATION & FLOOR

The foundation and floor slab are very important components of the workshop structure and must be carefully designed and built. No short-cuts should ever be taken at this stage.

CONCRETE APRON PAD

A large concrete apron pad in front of the main door makes an excellent outside servicing area. Make the apron at least as wide as the workshop. It should at least extend 5 metres (16 feet) in front of the building. The apron pad should be poured separately from the shop footing and should be poured lower than the shop floor. A 50 mm (2 in.) step helps to keep mud and snow melt from tracking into the shop and serves as a guide for the shop door.

It is important to drain the water which flows off the apron away from the edge of the pad. Good drainage can be achieved by extending a compacted gravel area at least 3 metres (10 ft) around the front and sides of the apron. The thickness of gravel need not be more than 50 mm (2 in.) although any pot holes which may appear should be filled in promptly. The edges of the apron should be rounded to prevent chipping.

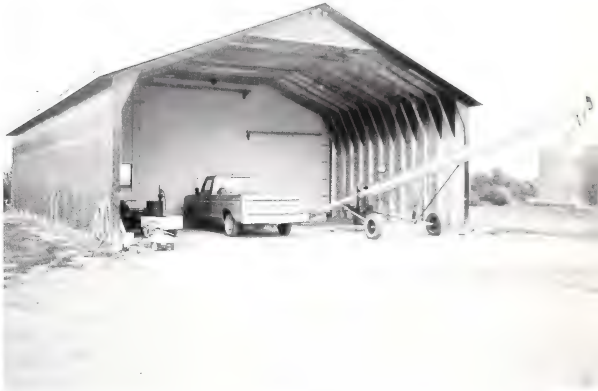
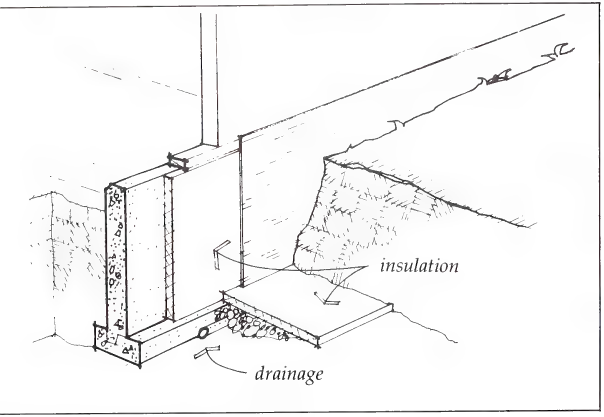
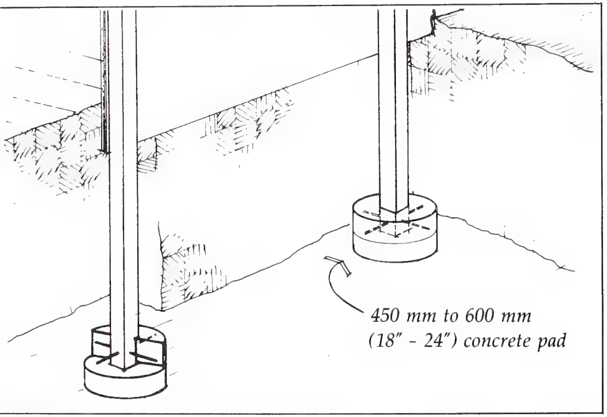


Figure 25. This workshop has a covered apron. Notice that the apron pad also extends well beyond the building. The east facing open front allows the morning sun to warm the apron but provides shade during hot afternoons.

FOUNDATION & FLOOR



igure 26. *Spread footing foundation.*



igure 27. *Pole frame foundation.*

THE BUILDING FOUNDATION

Foundations should be straight and level. Uniform soil conditions are particularly important to avoid uneven settlement. The foundation should also be free from frost action. For unheated buildings this means that the footings must extend below the frost level. Winter frost depth in the prairies can extend down to 2 metres (over 6 ft), and only a few of the common types of foundations can effectively get beneath the frost zone.

Frost penetration around heated buildings is not very deep due to heat loss from the building. To improve foundation performance it is best to insulate the foundation with 50 mm (2 in.) of styrofoam insulation as illustrated in Figures 26 and 32.

The spread footing is ideal for stud wall shops. Frost heave could be a problem if the site is poorly drained.

Grade beam and pile is an economical foundation for a large farm workshop. Because the diameter and spacing of the piers will be based on the soil bearing capacity, soil tests are recommended. A well built grade beam and pile foundation is probably the best type of foundation for large workshops.

Piles over 5 metres (15 ft) deep are usually used for steel frame buildings. Each pile carries a load of several tonnes from the steel frame. A perimeter grade beam, attched to the piles, closes in the building.

Pole frame workshops are a type of pile foundation with pressure treated wooden posts usually spaced 2.4 metres (8 ft) apart. The only concrete used in the foundation of a pole frame building is the concrete or gravel pad beneath each post.

A slab foundation is essentially the footing and floor poured together as one unit. Frost heave can cause considerable damage to a building with a slab-on-grade foundation, particularly in unheated shops. Except for the case of a small garage on a well drained gravel base, this foundation is not recommended for farm shops.

Ring foundations have been used with some success in very hard dry clay soils, although any success is due to the strength of the soil and not to the foundation itself. Ring footings are not recommended for farm workshops or machinery storages. Large buildings are too important an investment to trust to an inadequate foundations.

chapter 5 FOUNDATION & FLOOR

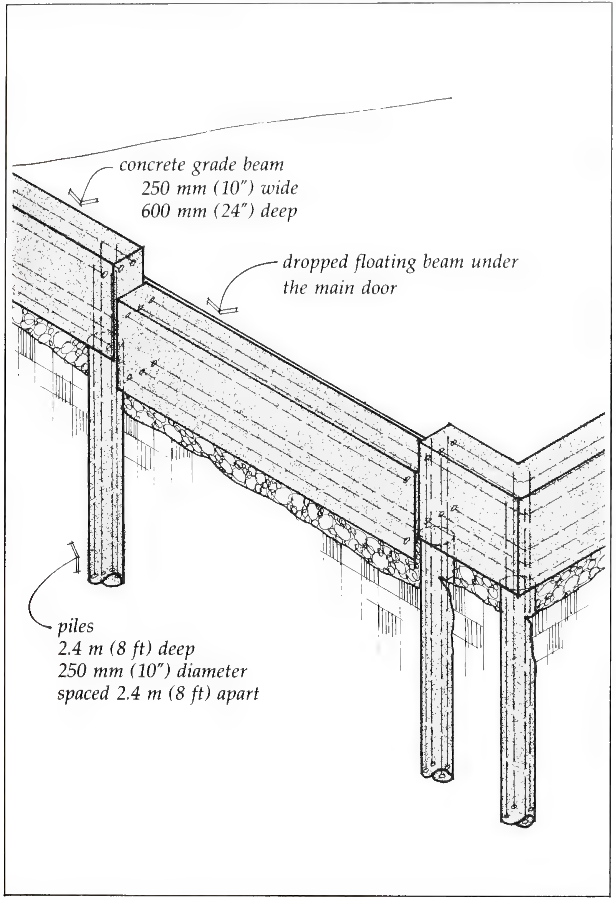


Figure 28. A typical pile and grade beam foundation.

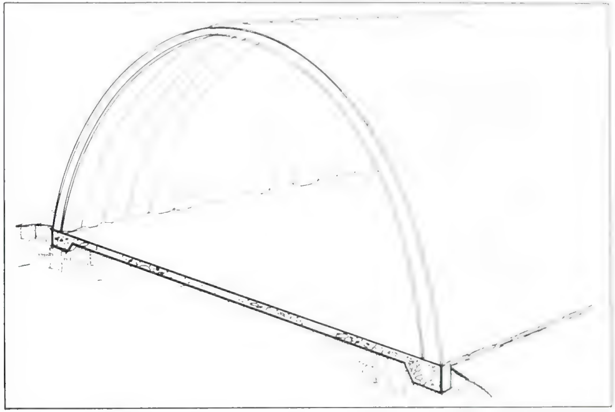


Figure 29. Slab foundation, only used for small garages.

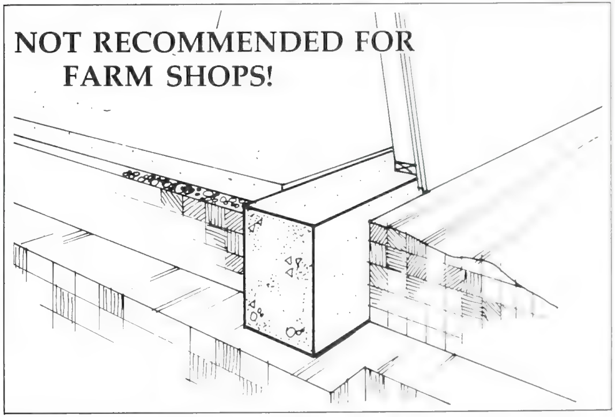
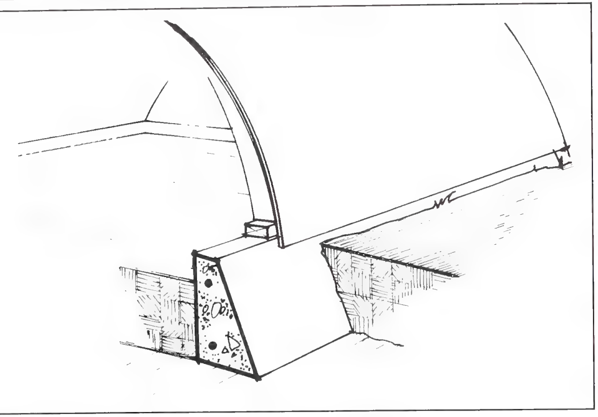


Figure 30. Ring foundatios are typically 600 mm (2 ft) deep and 300 mm (1 ft) wide. This is **NOT** *an adequate shop foundation.*



igure 31a. Tapered foundation for arch buildings.

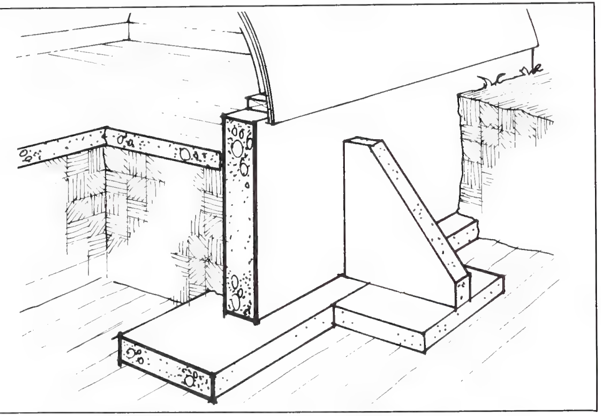


Figure 31b. Buttressed foundation for arch buildings.

Foundations for Arch Shaped Buildings

Any building with slanted walls is considered an arch building, this includes arch, quonset and slant wall steel frame buildings. Arch buildings exert a strong overturning force on their foundations which the foundation must be designed to counteract. Grade beam foundations, discussed previously, are often used with arch buildings. Care must be taken to insure that the piers and grade beam are well tied together. See Figure 32.

Manufacturers may require specially designed foundations for their buildings. In all cases this design must be followed. Figure 31a and 31b show two types of typical arch foundations developed by manufacturers

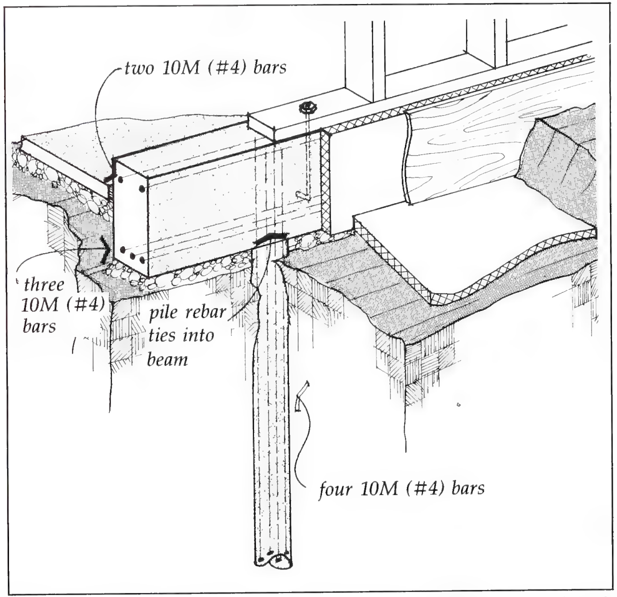


Figure 32. Rebar details for pile and grade beam foundation. With arch foundations it is especially important to tie the piles and beam together with reinforcing steel.

CONCRETE FLOORS

A high quality concrete floor is essential for a farm workshop. Workshop floors are subject to heavy point loads and are designed quite differently from livestock or grain storage floors. For instance, reinforcing steel cannot be properly placed to increase the strength of the concrete, but only to prevent cracks from widening. Correctly spaced control joints and a good sub-base will prevent more cracks than reinforcing. Design recommendations for concrete workshop floors are listed in Table 2. The most important aspect of concrete floor performance is to have a well prepared subgrade of uniform consistency, a well packed gravel base and good drainage.

Surface Treatment

Surface treatments can be used to control dust and staining by sealing the pores in the concrete surface. The best dust control however, is achieved by taking the time to finish the concrete with a good job of troweling.

Magnesium fluosilicate is the active ingredient in many brands of commercial concrete sealing compounds. The magnesium fluosilicate and water solution reacts with the the concrete to seal the pores producing a hard dense surface. Surface treatments may also be used to reduce oil staining of the concrete, however, do not expect magnesium fluosilicate or any other floor treatment to eliminate staining.

Floor Anchors

Anchors in the floor can be very useful for straightening or bending long pieces of metal or frames. It would be best to recess the anchors or at least have them flush with the floor surface. Install at least two anchors. See Figure 33.

TABLE 2. DESIGN RECOMMENDATIONS FOR CONCRETE SHOP FLOORS

Sub-base thickness	125mm	(5in.)
Floor slab thickness	150-200mm	(6-8in.)
Reinforcing mesh	150mm	(3in.)
Concrete strength	25Mpa	(3500psi)
Control joint spacing	3.6m	(12ft)
Control joint depth	40-50mm	(1.5-2in.)

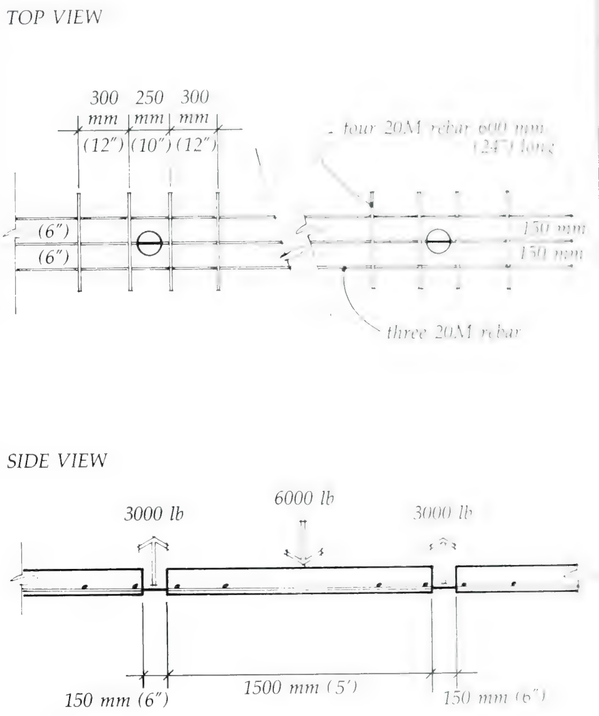


Figure 33. Floor anchor details.

igure 34. A floor drain placed across the main door tends to collect ud and debris.

Floor Drains

Floor drains are usually placed in the centre of the service area. A 200 mm by 2 m (8 in. x 6 ft.) grate-covered drain in the service area will be able to collect water and mud draining from vehicles as well as oil and wash water. A second alternative is to place the drain across the main vehicle entrance, however this drain will only stop mud from being tracked in. It is usually too far from the service area to collect oil and wash water.

Figures 36 and 37 show details for a typical shop floor drain. This drain is specifically designed to keep oil and solids out of the drain line. Notice that the drain line is not located at the bottom of the sump. This will keep a reasonable amount of solids from getting into the drain line. The T shape of the drain's standpipe will keep oil from entering the drainline.

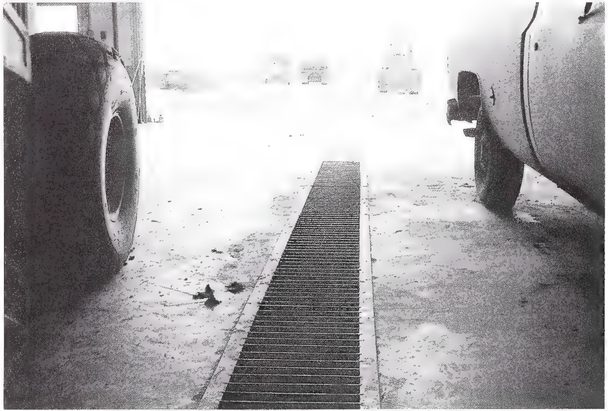


Figure 35. A floor drain placed down the center of the service area is recommended

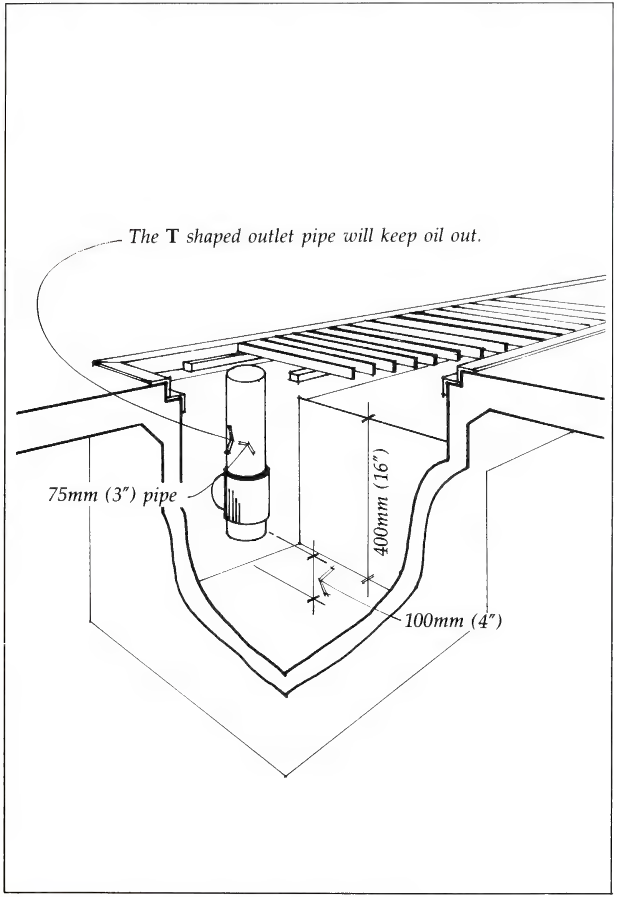


Figure 36. Details for a shop floor drain and sump.

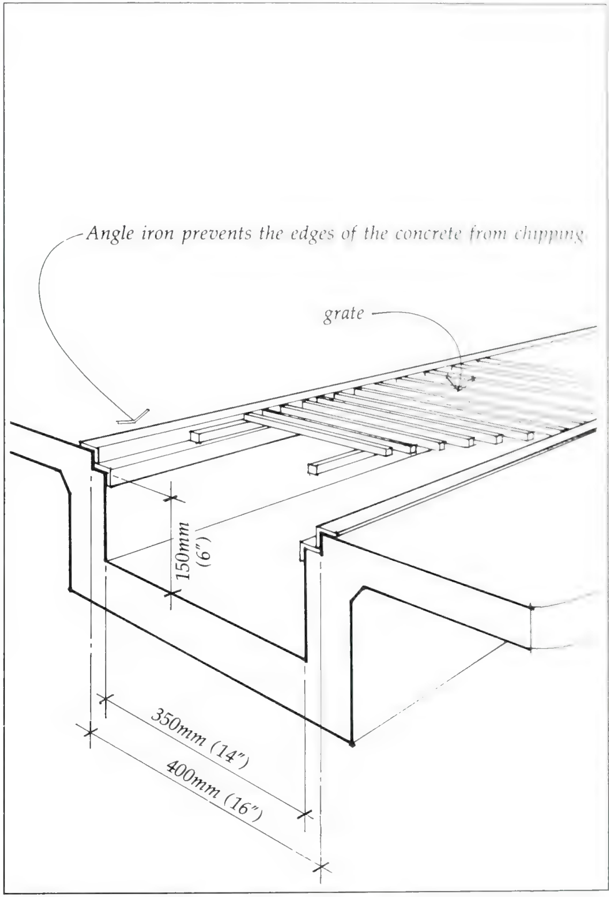


Figure 37. Floor drain.

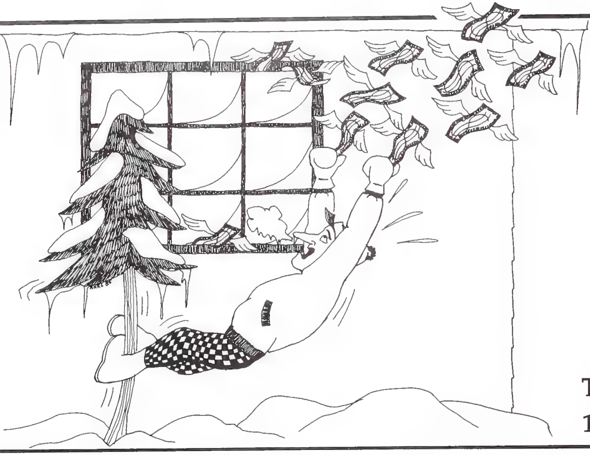


TABLE 3. TYPICAL HEAT LOSS THROUGH A 12m x 18m (40ft x 60ft) WOOD FRAME SHOP

	FOUNDATION		WALLS			CEILING		
	uninsulated	RSI .88 R5	RSI 2.1 R12	RSI 3.5 R20	RSI 7.0 R40	RSI 2.1 R12	RSI 3.5 R20	RSI 7.0 R40
YEARLY HEAT LOSS	22 GJ	12 GJ	37 GJ	22 GJ	11 GJ	28 GJ	17 GJ	8 GJ
YEARLY HEAT COST	$89	$50	$148	$89	$44	$111	$67	$33
COST OF INSULATION	—	$450	$570	$533	$1066	$427	$400	$900

Assuming - *$3.00 per GJoule*
- *75% furnace efficiency*
- *minimum shop temperature of 10°C (50°F)*
- *labour costs not included in cost of insulation*

chapter 6. INSULATION

RECOMMENDED INSULATION LEVELS

Farm shops are expensive buildings to heat mainly because of their large size and because of the significant heat loss around the main doors.

Recommended insulation levels are;
- Twenty-five millimetres (1 inch) of polystyrene RSI 0.9 (R5) for concrete foundations
- RSI 3.5 (R20) glass fibre batt insulation for walls
- RSI 3.5 to RSI 7.0 (R20 to R40) of either glass fibre batts or loose fill for the ceiling.

These recommended insulation levels are based on heat loss equations, prairie weather conditions, and fuel prices. The actual amount of insulation chosen for a new shop will depend on the farmer's concern for energy costs and the capital costs of construction. Table 3 will help make the decision.

Insulation of the concrete foundation of a heated farm shop is a must. Concrete is such a poor insulator that a heated 12 m by 18 m (40ft x 60ft) shop will lose $89 worth of heat (at 1985 fuel prices) per year through an uninsulated foundation.

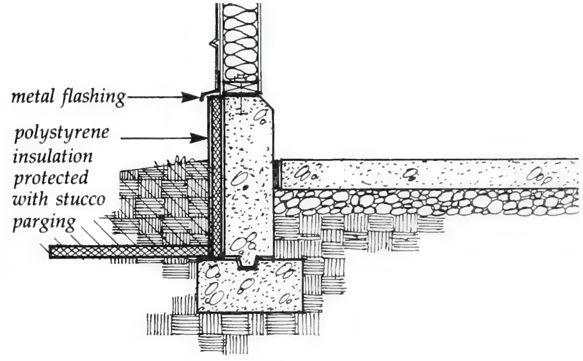
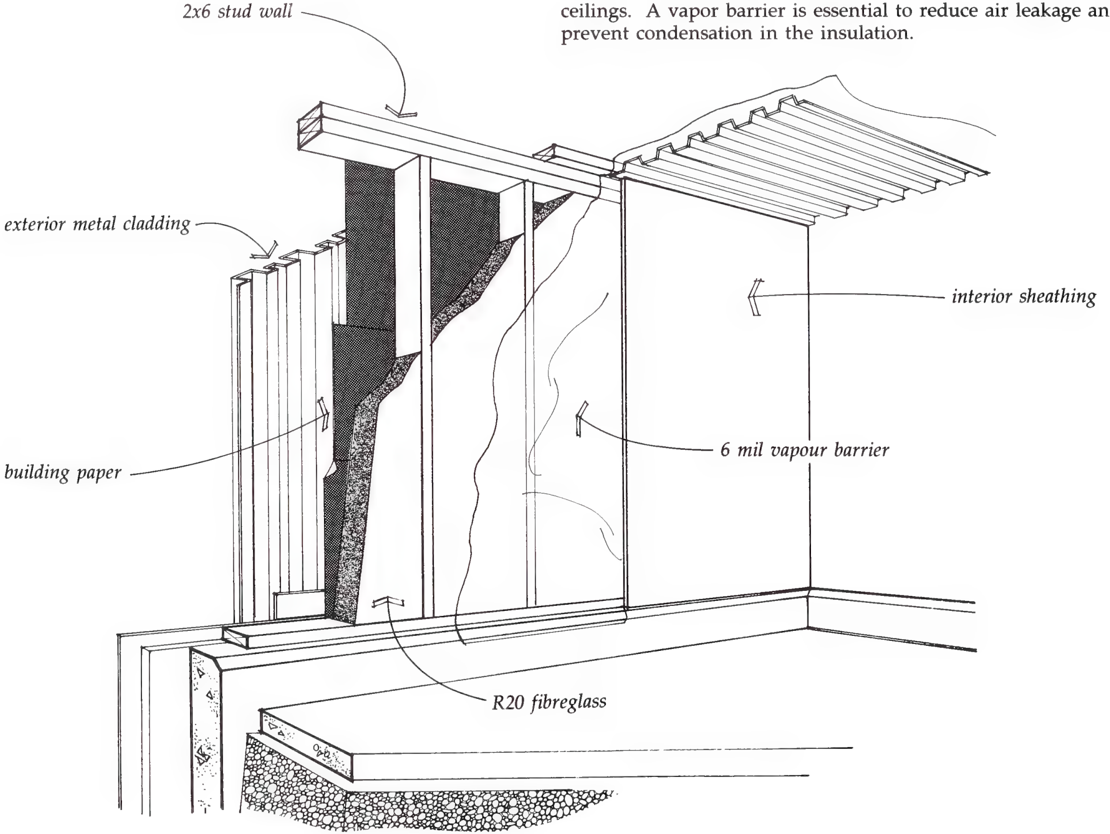


Figure 38. Perimeter insulation is a good investment.

INSULATION

INSULATION FOR WOOD BUILDINGS

Pole frame, stud wall, and wooden arch buildings are best insulated with fibre glass batts for walls and batts or loose fill for ceilings. A vapor barrier is essential to reduce air leakage and prevent condensation in the insulation.



igure 39. Stud wall insulation.

INSULATION FOR METAL BUILDINGS

Metal quonsets and metal frame buildings are often difficult to insulate properly. Manufacturers of metal buildings usually sell the insulation system best suited to their product, usually a foil or vinyl backed fibreglass batt system. Metal buildings should be insulated when they are erected. If insulation is desired in a year or two it is often difficult to get the contractor to return and do the job. Also, spray-on insulation cannot be applied effectively to dirty walls.

Cellulose is a spray-on product usually made from recycled paper. It is soft and fluffy, which makes it prone to damage. Make sure that the cellulose product you choose is C.S.A. approved, this will ensure that the insulation has been treated with the proper fire retardants. Twenty-five millimetres (1 in.) of cellulite has an insulation value of approximately RSI 0.7 (R4). Spray-on cellulose insulation has no vapour barrier and can peel off the walls and ceilings under damp conditions.

Polyurethane foam is easy to apply to all types of structures. Contractors using special equipment spray the raw foam onto surfaces to be insulated. The foam froths up and hardens rapidly after application forming a relatively tough, air tight, well bonded insulation. The metal surfaces of the building should be clean and free of oil or dust, otherwise the polyurethane may not bond properly to the metal. In addition, polyurethane must be applied when the temperature is within the manufacturer's recommended range — usually 15 to 20°C (60 to 70°F). Polyurethane is an excellent insulator with an insulation value of RSI 1.1 per 25 mm (R6 per inch).

The main disadvantage of polyurethane is its fire hazard. Exposed polyurethane foams have contributed to a number of farm shop fires. Some polyurethanes and polystyrenes are highly combustible and will burn as a flash fire. Flames spread almost instantaneously over the exposed surface and the burning foam produces dense smoke, toxic fumes and hot gases.

Cover the exposed foam with a fire barrier. One commercial application is Zonolite 3300. Other plaster-like compounds are available, usually from foam applicators.

The Alberta Building Code requires exposed foam be protected by a fire rated covering. Although the Alberta Building Code does not apply to farm construction, the opportunities for fire do. The temptation to cut costs by leaving foams exposed must be weighed against the possibility of rapid fire spread after ignition.

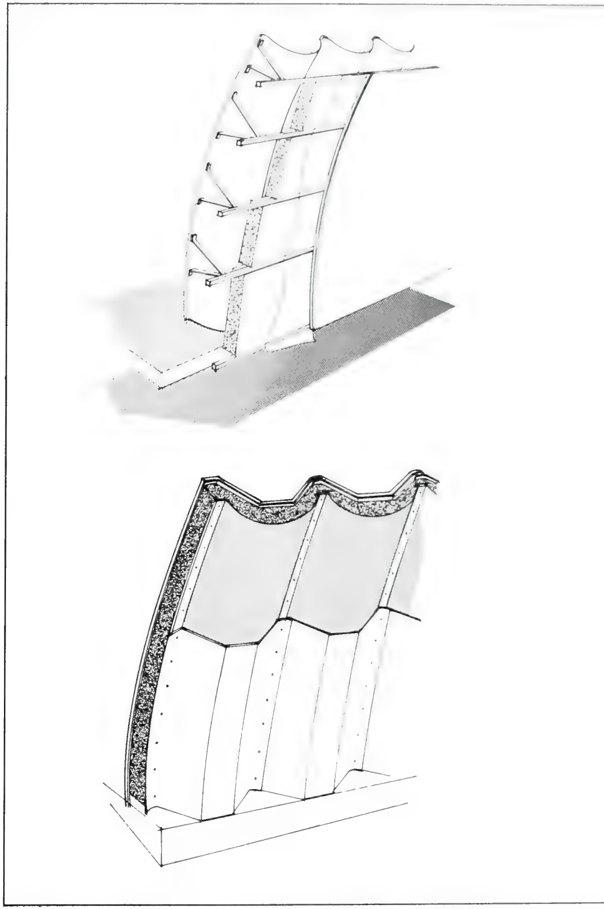


Figure 40. Metal quonsets can be insulated with fibre glass insulation...but it isn't easy.

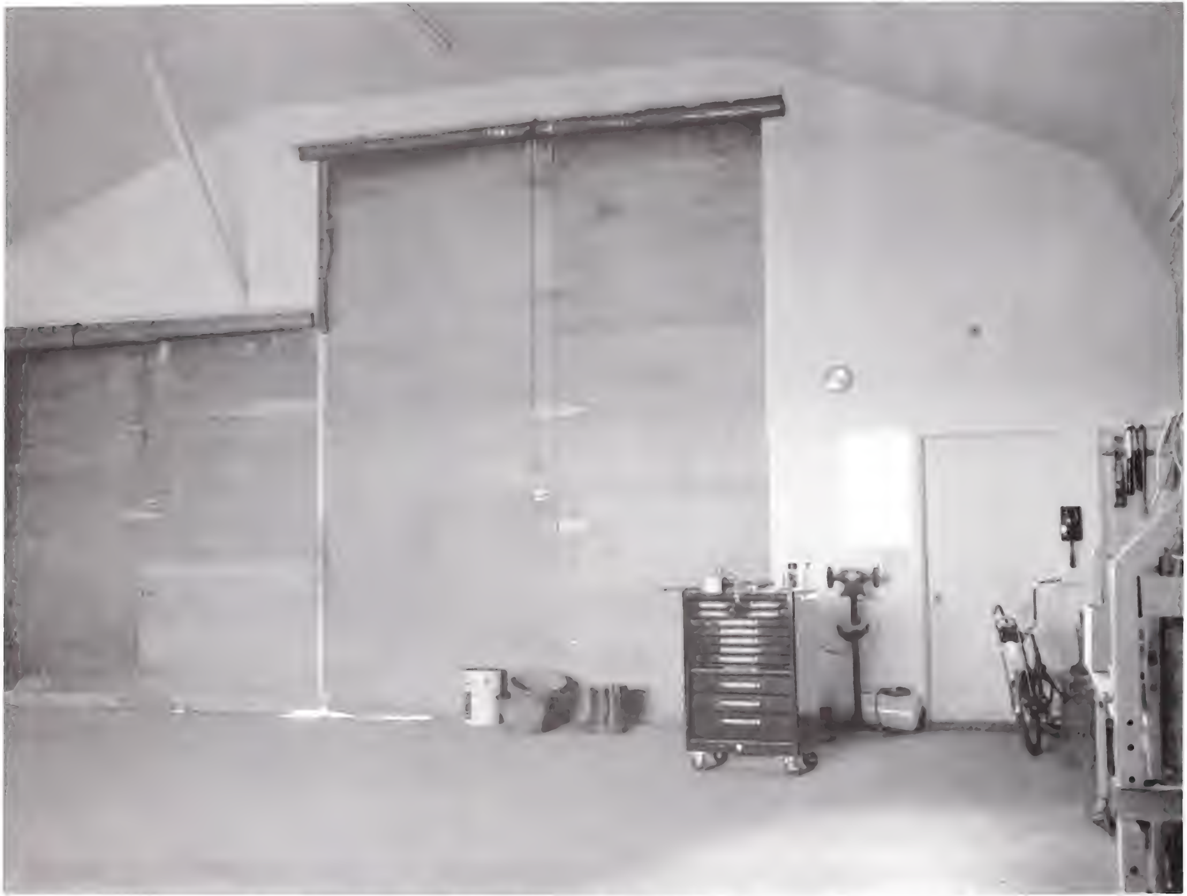


Figure 41. This workshop has a set of two large bifold doors of different sizes. Notice the plastic draft curtains rolled up above each door.

chapter 7. DOORS

ENTRANCE DOOR

A man door near the large door is essential to avoid opening and shutting the large door each time entry is desired. Make the entrance door 1 metre (3 ft) wide to allow reasonably large sized objects to be moved into the shop without opening the main door. The door should open inward to avoid problems with snow and possible wind damage. A heavy-duty insulated door mounted on sturdy hinges is recommended.

LARGE DOORS

Large insulated shop doors are a costly investment and a well planned workshop usually needs only one large door sized to accommodate the largest piece of farm equipment (with the possible exception of a large swather). Most machines will fit through a 5 metre (16 ft) wide entrance. On large farms this requirement may be 6 or 7 metres (20-24 ft). Protect the door frame with a steel or wood bumper post. A steel tube filled with concrete will make a permanent bumper but a wooden post (such as a power pole stub) will do less damage to machinery when hit.

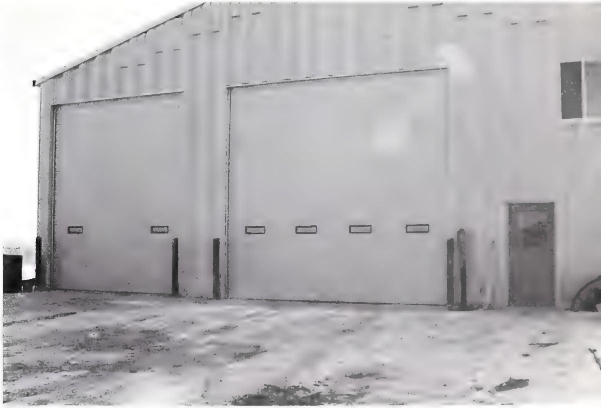


Figure 42. This shop also has two different sizes of doors, one wider than the other. Notice the steel bumper posts.

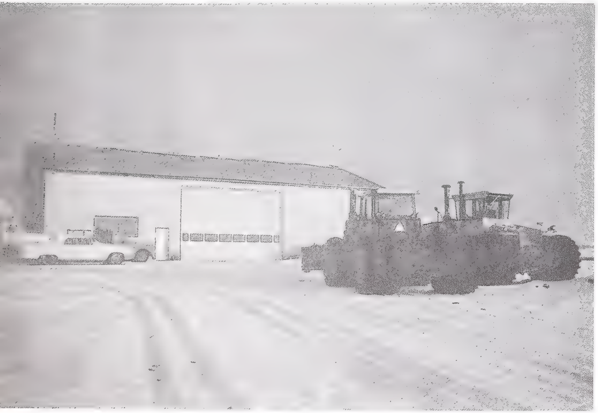
igure 43. *End wall doors can be nearly as wide as the building. This fold door is 6 m (20 ft) wide and partially hung from the building's nd roof truss.*

End Wall Doors

Locate the large door on an end wall. End wall doors are easier to frame, less costly to hang, have greater head room and do not have to support the building's roof trusses. In fact end wall doors can be hung from a double truss or from a header track specified by the door manufacturer. Endwall doors can be nearly as wide as the building without affecting the roof structure.

Side Wall Doors

Side wall doors require an extra heavy lintel beam to support the weight of the roof trusses. These lintel beams can be costly and reduce clearance. Side wall doors also have problems with ice and snow sliding off the roof and landing right in front of the door.



gure 44. *A side wall door requires a heavy overhead beam to support e weight of the roof trusses over the door.*

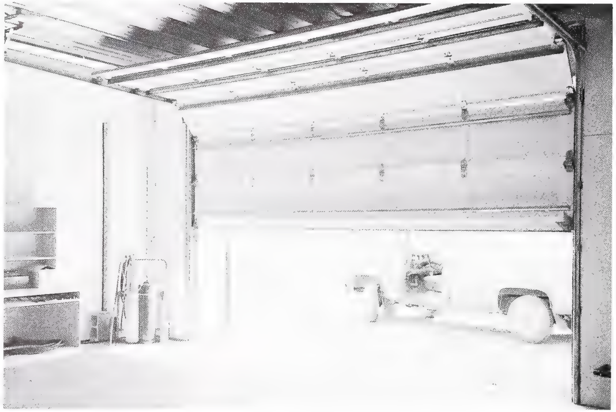


Figure 45. Sectional overhead door.

chapter 7 DOORS

There are three types of large doors: sectional overhead, sliding, and bifold. All work well if properly installed with good hardware.

Sectional-Overhead Doors

Overhead doors are by far the most convenient type of work shop door. They are easy to open regardless of wind or snow conditions and can be automated. Overhead sectional doors usually require 0.3 metres (1 ft) of head room for the overhead track. However, their greatest disadvantage is cost, a 4.2 metre by 6 metre (14 ft by 20 ft) insulated door would cost $2600, an uninsulated one would cost $1700.

Sliding Doors

These doors have been used for years on farm buildings and have been the subject of both praise and criticism. They are difficult to weather strip and will sag if not properly constructed. Sliding doors are vulnerable to wind damage and snow build-up. However, they are inexpensive and easy to construct. Commercial wood and steel sliding doors are also available.

Bifold Doors

The bifold door is usually constructed in four sections. Two sections are connected by hinges and are suspended from the top, fitting into a guide socket at the bottom. The centre edge of the double panel is supported by a roller that slides in a track. Pushing the centre edge towards the jamb causes the door to fold like an accordion. These doors are suitable for openings up to a size of 7 metres by 4.2 metres (24 ft x 14 ft), and are built in 1.5 to 1.8 metre (5 to 6 ft) wide panels. They are easier to seal than sliding doors and when folded, are protected from wind damage.

Figure 46. Sliding door.

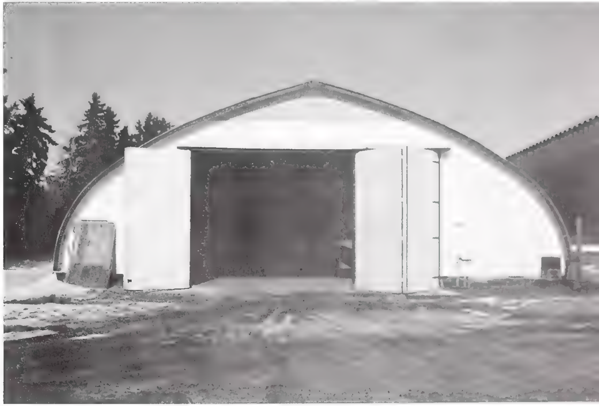


Figure 47. This bifold door folds outwards.

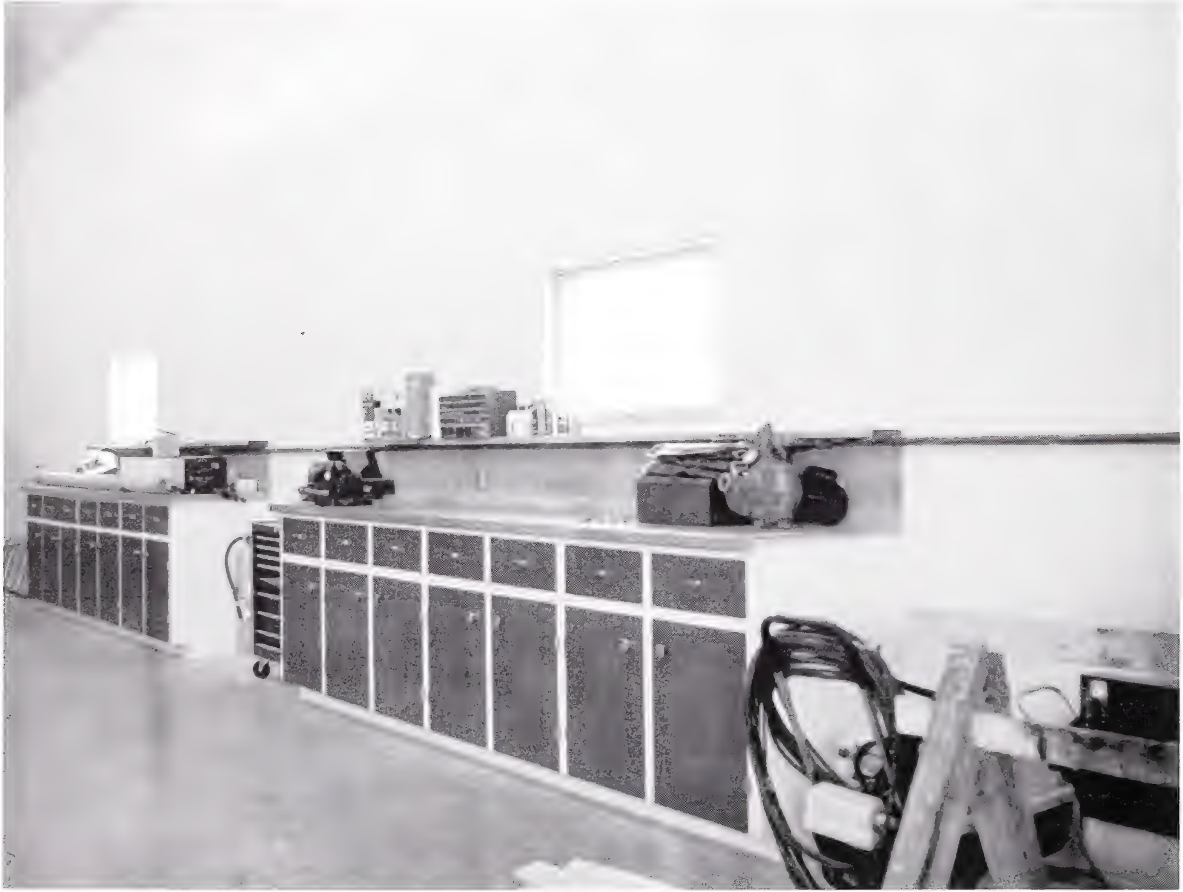


Figure 48. *A brand new workshop finished with drywall and painted with a light color to reflect light.*

chapter 8. INTERIOR FINISHING

It is undesirable to leave the vapor barrier and insulation exposed in a farm shop. It is best to install the interior sheathing immediately after insulating. Interior walls should be inexpensive and durable. The bottom 2.4 metres (8 ft) of the wall should be especially durable. There are several suitable materials:

- Drywall is the least expensive finishing material and has the advantage of being fire resistant. It is easily damaged but it is also easy to repair. It will require painting periodically.

- Chipboard is a fairly durable product and is an inexpensive type of wood sheathing. It can be painted or stained but it makes a rough surface. Particle board is a denser, tougher sheathing that takes paint readily. Both these board products are flammable.

- Metal sheathing comes in galvanized sheets or enameled (prepainted) panels. 30 gauge steel sheathing is adequate for wall sheathing. A vapour barrier is still necessary with metal sheathing. All types of metal sheathing are vulnerable to dents and damage which are difficult to repair, otherwise they present a maintenance free finish.

- Plywood is often used for shop interiors. 6 mm (0.25 in.) plywood is adequate for sheathing.

One of the best low cost compromises for tough, durable, fire resistant construction is to drywall the entire interior, but protect vulnerable areas such as at the workbench, door areas, or even the entire lower half of the wall with an overlay of particle board (tough but not fireproof), or tin sheathing (impervious to welding sparks).

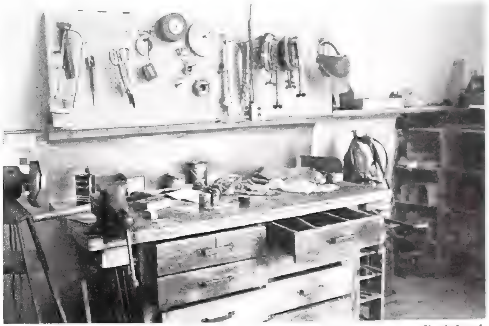


Figure 49. This bench and the wall behind it are finished with tin for safety, durability and easy cleaning.

ABLE 4. COMPARING LAMP TYPES

YPE	COLOR	LAMP WATTAGE	LIGHT BULB COST *	BALLAST WATTAGE	EFFICIENCY (lumens/watt)	LAMP LIFE (hours)	AGRICULTURAL USES
candescent	White	40	$0.45	no ballast req'd	10	1,000	indoors
		60	$0.45		13	1,000	outdoors
		100	$0.55		15	1,000	where temperatures vary greatly
		300	$2.38		20	1,000	where dimming is required
uorescent	White	40	$1.05	8	65	20,000	indoors **
		96	$3.25	15	90	12,000	
ercury	Bluish White	250	$19.70	35	39	24,000	yard light
		400	$21.60	50	46	24,000	high ceiling indoors
etal Halide	Bright White	175	$42.00	40	65	7,500	yard light
		400	$37.25	50	76	15,000	high ceiling indoors
gh Pressure Sodium	Golden White	100	$40.00	16	82	20,000	yard light
		250	$40.00	53	88	24,000	high ceiling indoors
		250	$40.00	75	105	24,000	color correction available
w Pressure Sodium	Amber Yellow	35	$47.90	29	75	18,000	yard light
		90	$58.15	35	108	18,000	
		180	$106.65	30	157	18,000	

1985 Edmonton prices.

** *If used for temperatures below 10° C, use special cold start ballast.*

mps are classified into 6 major groups:

Incandescent
Fluorescent
Mercury
Metal Halide
High Pressure Sodium
Low Pressure Sodium

The efficiency of each lamp type can be compared by measuring **Lumens/Watt**.

Lumen measures the amount of light output. As the number of lumens increases, the light output becomes greater.

Watt measures the amount of electricity drawn by the lighting system. For incandescent lights, the wattage is indicated directly on the bulb. For the other 5 lamp types, you must add both the lamp and ballast wattage to determine the total wattage.

Ballast is a device used with most lamps to obtain necessary circuit conditions for starting and operating.

chapter 9. LIGHTING

WINDOWS

Natural lighting cannot be relied on as the main light source for farm shops. The main use for windows in a shop is to keep an eye on the farm yard and to make the shop a more pleasant work area. Windows can provide enough light to find one's way around and may be helpful on each side of the workbench. Don't put windows directly over the workbench. When the sun is bright it will create shadows and glare which makes the bench difficult to work at.

LIGHTING REQUIREMENTS

General lighting

Overhead lighting gives enough illumination to perform general work such as removing a component from a machine or adjusting a belt. Paint the interior of the shop white for brighter working conditions.

Bench lighting

Extra lighting for the work bench is generally supplied by a continuous double row of fluorescent lights mounted about 1.5 metres (5 ft) above the bench. These lights can be mounted

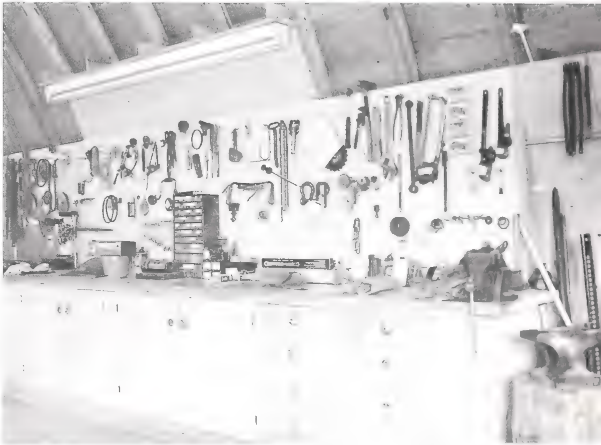
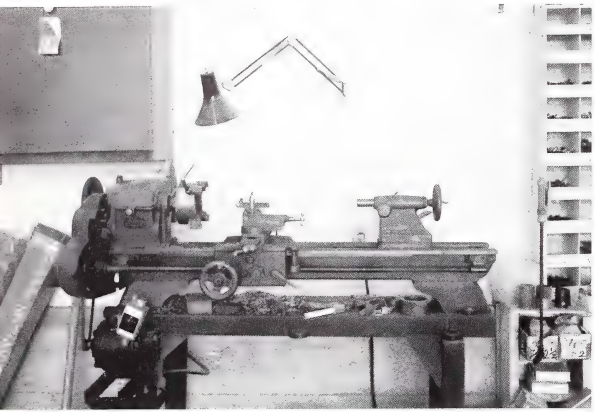


Figure 50. A double row of fluorescent tubing provides a good level of bench lighting.



igure 51. *Incandescent spot lighting is recommended for machine ools.*

directly on the wall, however, they cast light more efficiently, and are less likely to dust up when mounted in a fixture.

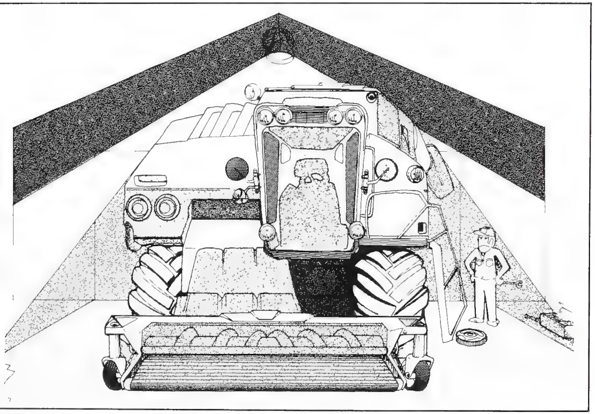
Spot lighting

Spot lighting should be provided at each machine tool such as a lathe, drill press, hydraulic press or grinder. Adjustable study lamps are an inexpensive way of providing spot lighting.

Fluorescent and high intensity discharge lamps flicker. The frequency is high enough that it can't be noticed by the human eye, however it can make rotating machinery appear stationary . Avoid this problem by using incandescent lights to illuminate rotating equipment.

Exterior lighting

Two yard lights are recommended. When two exterior lights are mounted, one on each side of the main door, no shadows are cast. The reflectors should be directed at an angle of about 20 to 30 degrees away from the building to spread the light in front of it as far as possible. A standard yard light fixture with a 300 watt



igure 52a. A single exterior light casts shadows around large quipment.

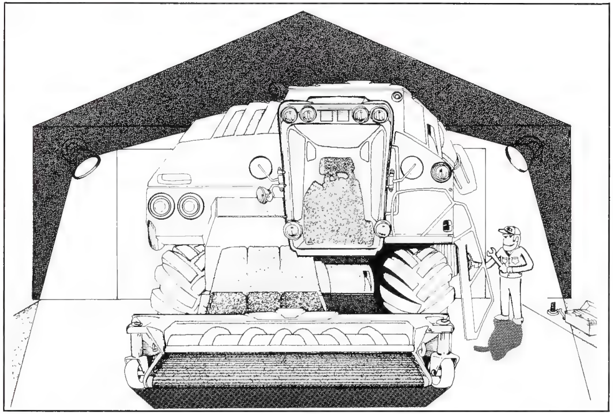


Figure 52b. A pair of angled exterior lamps makes night repairs easier.

incandescent bulb is recommended. Two of these fixtures will give enough light to work on equipment parked on the apron.

LAMP TYPES

Three types of lamps are available. These are incandescent, fluorescent and high intensity discharge (H.I.D.) lamps. Each type has properties which must be considered when selecting equipment for a lighting system. These properties include size, light output, energy efficiency, amount of control, maintenance, color, cold starting ability, and cost. See Table 4 on page 34 for comparison information.

Incandescent Lamps

For general lighting, incandescent lamps need reflectors to increase directional light output. Unlike fluoresent and high intensity discharge lights, incandescent light are not affected by cold temperatures.

Fluorescent Lamps

Fluorescent lamps are generally designed to operate in temperatures from 21 to 32°C (70 to 90°F). In cold areas, such as unheated shops, a special low temperature lamp with a high output ballast can be used, however, it is more expensive. A cheaper alternative is to provide a few incandescent lights which can be used while the fluorescents are warming up. It must be kept in mind that a fluorescent light gives off light in equal amounts around the tube and it is the reflector which directs light downwards.

High Intensity Discharge

High Intensity Discharge (H.I.D.) lamps are compact, efficient, high output light sources, even with their high initial cost they are becoming popular for agriculture applications because of their energy efficiency and long life.

Because HID lamps require a 10 to 20 minute warm-up period they are not suited for frequent on/off applications. Provide a few incandesent lights which can be turned on during quick trips into the shop.

TABLE 5. RECOMMENDED LIGHTING FOR FARM SHOPS

GENERAL SHOP LIGHTING

- One fluorescent lamp fixture (with two 2.4 metre (8 ft) tubes) for every 40 square metres (400 sq. ft) of shop floor area.

or

- Two fluorescent lamp fixtures (with two 1.2 metre (4 ft) tubes) for every 40 square metres (400 sq. ft) of shop floor area.

or

- One 400 watt mercury vapour lamp for every 40 square metres (400 sq. ft) of shop floor area.

SPOT LIGHTING

- One 100 watt incandescent light fixture (with an adjustable arm) at each stationary piece of equipment.

BENCH LIGHTING

- A continuous double row of fluorescent tubes mounted in a reflecting fixture.

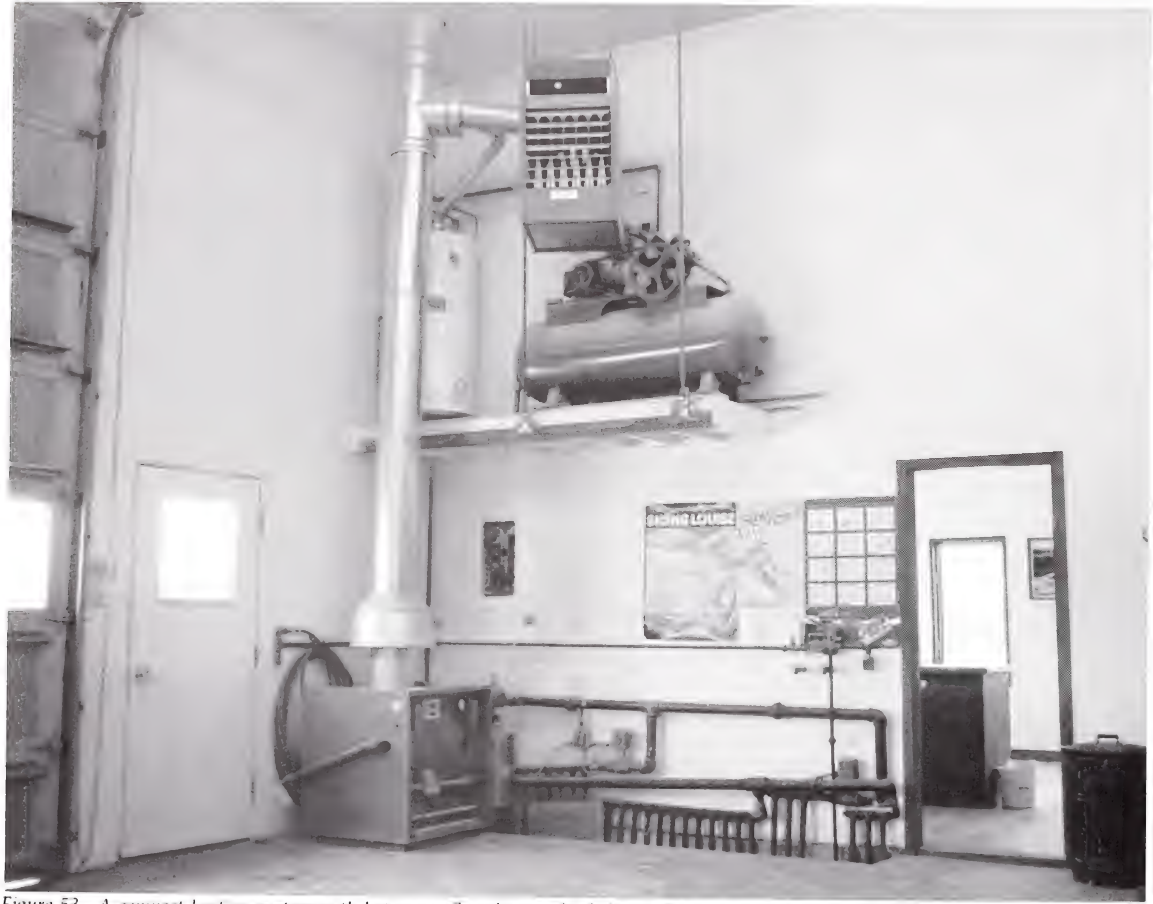


Figure 53. A compact heating system with hot water floor heat and a boiler at floor level, and a hot water heater, unit heater (and compressor) up above.

chapter 10. HEATING

There are several heating alternatives for farm shops: unit heaters, forced air furnaces, floor heat and radiant heat. These alternatives are discussed in the following sections, however, sometimes the best heating system is a combination of floor heat and one of the other systems.

UNIT HEATERS AND FURNACES

Unit heaters and forced air furnaces are common means of heating farm shops. These systems are relatively inexpensive, easily installed and can be purchased second hand. Install one or two ceiling fans to prevent the warm air from stratifying. Both gas unit heaters and furnaces must be vented to the outside of the building.

RADIANT HEATING

Infrared heaters have the advantage of only heating those objects which are exposed to its rays. The air between the object and the heater is not heated. They are particularly useful if you don't want to heat the entire shop, just the work bench.

Radiant heaters are available in electric or gas models. The reflectors of radiant heaters must be kept clean if they are to be effective.

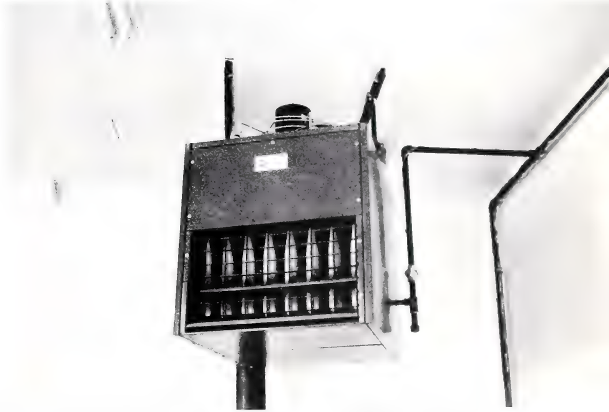
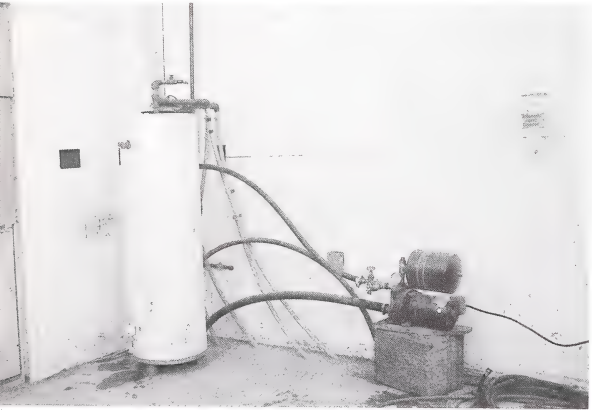
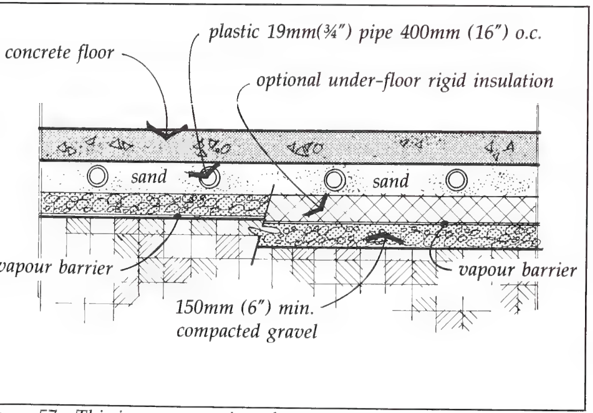


Figure 54. A workshop unit heater is a quick source of heat.



igure 56. *A hot water heater can be used in a small to medium sized oor heat system.*



ure 57. *This is a cross section of a typical shop floor heating system.*

HOT WATER FLOOR HEAT

Floor heat has become a popular method of heating work areas. The higher installation cost of this system can be justified because it is safe, efficient and maintenance free. In addition, it provides a very comfortable working surface. Floor heat does not respond rapidly to sudden heating loads, such as when the main shop door is opened. Because of its slow response time, and because there is a limit to the amount of heat that can be put through the floor, shops with floor heat usually have an auxilary unit heater to handle the overload.

Since the water in floor heat systems does not exceed 60°C (140°F) an ordinary hot water heater can be used; larger systems may use a boiler. The distribution system uses parallel loops of plastic pipe buried under the concrete floor. Consider priming the lines with a glycol solution to prevent freezing when the heat is turned off. Do not use automotive antifreeze, it "wears out" and needs replacement.

The size of the hot water heater can be calculated by multiplying the floor area (in square metres) by 225. This will give you an estimate of the size of the hot water heater required in Watts. To determine the heater capacity in Btu/hr, multiply the floor area (in square feet) by 75. For example; to heat a 40 ft x 60 ft floor a 180,000 Btu/hr (40 x 60 x 75) hot water heater is necessary. You will still need an additional heat source, such as a unit heater, to complete your heating system.

CALCULATING WORKSHOP HEATING REQUIREMENTS

Calculating the heating requirements of a workshop is more difficult than for any other building. This is because of the large doors. Opening and closing shop doors in cold weather puts a tremendous load on the heating system.

Use Table 6 to calculate the total furnace or boiler requirements of a workshop. To use the table, first calculate the floor area in square feet. Pick the column which has the square footage closest to your calculated number. Circle the heat loss values which suit your building. Add the circled numbers. The total is the output Btu/hr capacity of your heating system. For anyone who wishes to work in Watts and square metres, there is a metric version of this table in the appendix.

TABLE 6. DESIGN HEAT LOSS IN BTU/HR (used to size a shop furnace system)

BUILDING COMPONENT	FLOOR AREA (square feet)						
	500	1000	1500	2000	2500	3000	3500
FOUNDATION							
uninsulated	6800	9600	11800	13600	15200	16700	18000
insulated (R5)	4100	5800	7100	8100	9100	10000	10800
WALLS							
R12	9700	13700	16800	19400	21700	23800	25700
R20	5800	8200	10100	11600	13000	14300	15400
CEILING							
R12	3800	7500	11300	15000	18800	22500	26300
R20	2300	4500	6800	9000	11300	13500	15800
R32	1400	2800	4200	5600	7000	8400	9800
R40	1100	2300	3400	4500	5600	6800	7900
AIR LEAKAGE							
large door rarely opened	12000	24000	36000	48000	60000	73000	84000
large door often opened	22000	44000	66000	88000	110000	130000	150000

Based on: a temperature difference of 90°F and a 14 ft ceiling height

EXAMPLE USING TABLE 6:

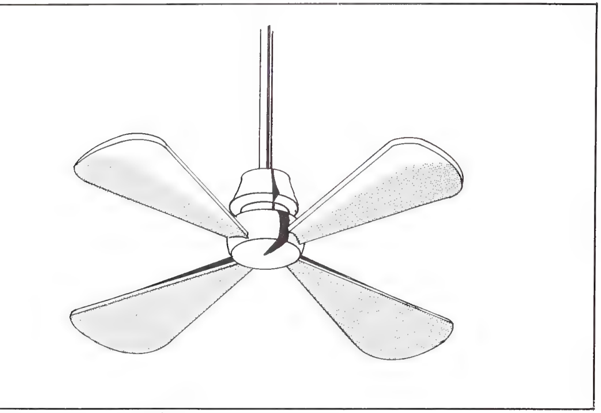
For a 40 ft by 60 ft shop with R20 in the walls and ceiling, one inch of styrofoam (R5) perimeter insulation, and a large door rarely opened in the winter.

Floor Area = 40 ft x 60 ft = 2,400 square feet

Use the column for 2,500 square feet

Total heat requirements = 9,100 + 13,000 + 11,300 + 60,000
= 93,400 Btu/hr

Choose a furnace or boiler which is rated at 93,400 Btu/hr **INPUT**.



igure 58a. *Ceiling fan for air circulation.*

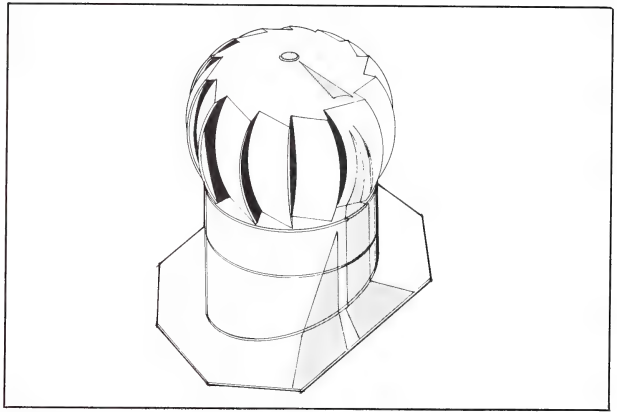
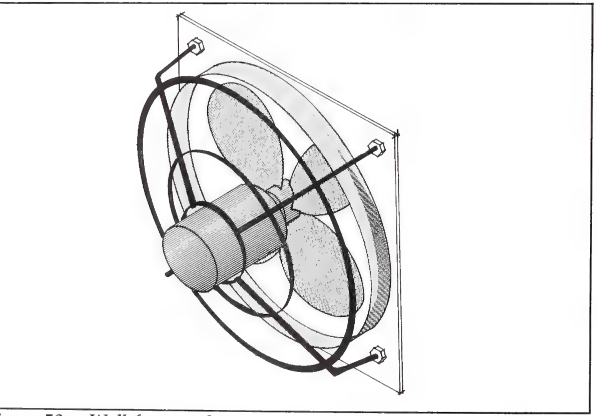


Figure 58b. Ridge vent to help reduce moisture build up in cool buildings.



gure 58c. *Wall fan to exhaust welding fumes.*

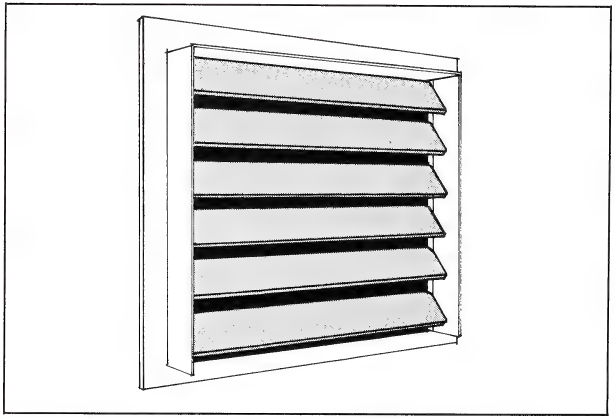


Figure 58d. Louvered inlet to help prevent drafts.

chapter 11. VENTILATION

CEILING FANS

Ceiling fans promote good air mixing. Low speed circulation fans mounted on high ceiling workshops save heating costs and produce better working conditions. Two fans should be adequate for buildings up to 12 metres by 21 metres (50 ft x 70 ft).

RIDGE VENTILATORS

Moisture accumulation often occurs inside a farm shop, especially metal clad shops. This problem often cannot be completely solved because the solution may not be economical, however, ridge ventilators placed every 8 metres (25 ft) down the ridge line may help. Having a well insulated building will also help to keep moisture problems to a minimum.

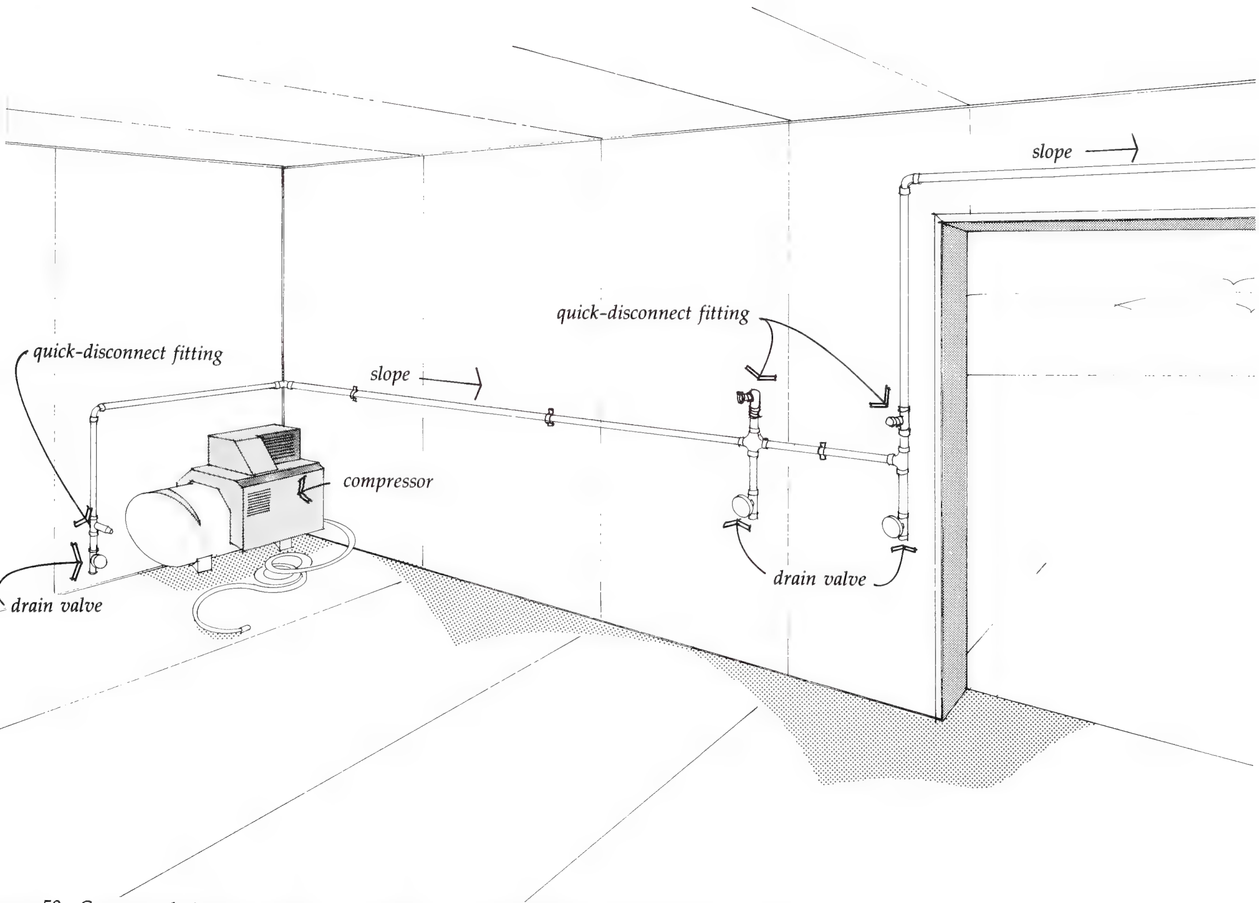
WELDING

A 300 mm (12 inch) single speed fan is adequate for exhausting welding fumes. Mount the fan 3 metres (10 ft) up the wall nearest to the welding area. A fume hood is usually not practical in a farm shop because welding cannot be restricted to one location. Locate the welding area near the main door. The door can be left open to provde extra ventilation during fair weather or welding can be done outside if weather permits.

NOTE: When fan ventilation is installed in any building, a louvered (or baffled) inlet vent must also be installed. The inlet is usually placed high up on the end wall. The purpose of the inlet is to bring in fresh air (to replace the air exhausted through the fans) without causing drafts inside the building. A 300 x 300 mm (1 ft x 1 ft) louvered panel will be able to provide enough air to supply a 300 mm (12 inch) exhaust fan.

VENTILATION ENGINE EXHAUST

When operating engines in a building, attach flexible tubing to the engine exhaust. The tubing can be connected to permanent wall ports located around the perimeter of the building at floor level. In order to prevent back-drafting, do not locate any of these ports near doors and windows.



gure 59. Compressed air supply using 12.5mm (½ in.) copper pipe sloped away from compressor. Supply quick-disconnect fittings for outlets, drainage below all outlets, and vertical rises in pipe.

chapter 12. UTILITIES

COMPRESSED AIR SUPPLY

The air supply system in large and medium sized workshops should have several air outlets throughout the shop. Outlets will be needed in the service area for cleaning, and operating air tools, in the machining area and the clean area. An outlet is required beside the main door for filling tires and operating air wrenches on equipment parked outside. Water and oil traps are required to separate condensed water and oil which may get into the system from the air compressor.

If the air compressor is portable, it can be connected to the air system through a quick-disconnect fitting. Thus, it will be easier to disconnect and transport to other locations when required.

Horizontal air supply pipes should be sloped slightly at 5 mm/m (1/16 in. per ft) away from the compressor for water to drain. A water drain is provided at the far end of the pipe to periodically drain the accumulated water.

WATER SUPPLY

A water supply system for large and medium sized workshops should be considered. It will be used for washing equipment and floors, washroom facilities and fire protection. Water outlets are provided beside the main door and in the vicinity of the service area.

Farm shop water lines must be easy to drain. It should be possible to shut off the water supply below frost level when the shop is not being used. Horizontal pipes should be sloped slightly at 5mm/m (1/16 in. per ft) towards the supply to ensure that they will completely drain when required. A hydrant, located beside the main door, will provide water for fire fighting even if the water supply to the shop is turned off.

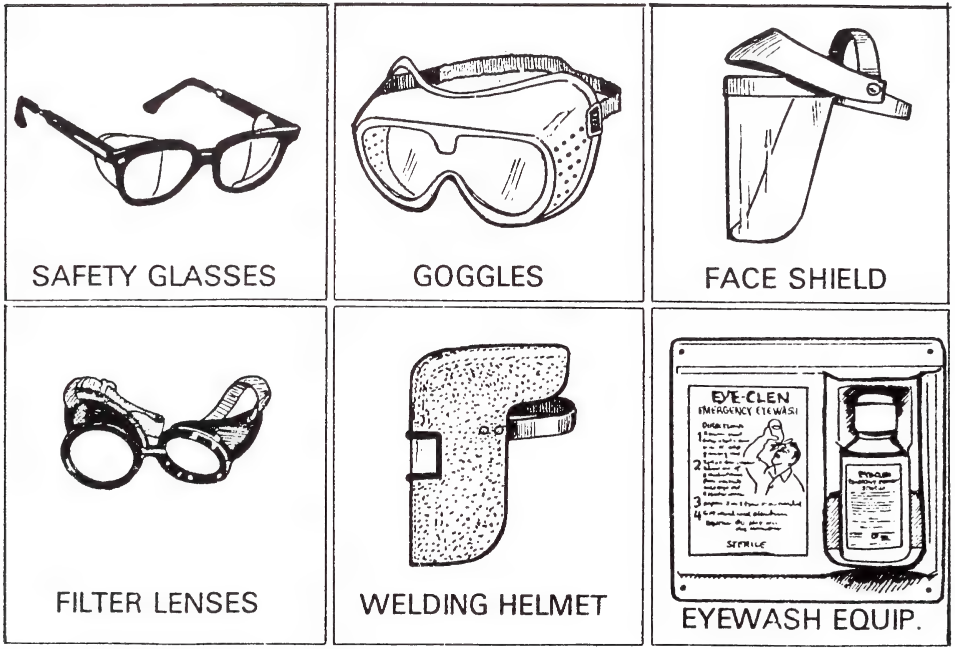


Figure 60. Equipment for Eye Protection

chapter 13

SAFETY

- Adequate blocking and stands must be available for supporting raised equipment.
- Use flexible metal hose to duct exhaust fumes from engines to the outside.
- A fireproof blanket is useful to cover objects which may be damaged from flames or welding sparks.
- Locate a multi-purpose dry chemical fire extinguisher near the exit and away from flammable materials.
- Use welding goggles and helmets when welding or assisting with welding.
- Have proper ventilation in the welding area. Make surrounding walls and curtain partitions non-combustible.
- Clothes that have excess oil or grease on them or if they are made of synthetic material can catch fire easily.
- Store cleaning cloths and combustible materials in a covered metal container.
- Wear gauntlet style gloves when welding or heating metal.
- Provide a fire proof blanket to smother clothes fires.
- Avoid loose clothing and protect long hair from moving parts.
- Safety goggles prevent eye injuries from flying metal parts.
- All work should be properly clamped before any machining is undertaken.
- Stairs must be sturdy and have a hand rail.
- Large, heavy parts hung on a wall must be securely fastened.
- Mount a 10 lb multi-purpose dry chemical fire extinguisher by the exit.
- Fire proof containers for rags would be an asset.

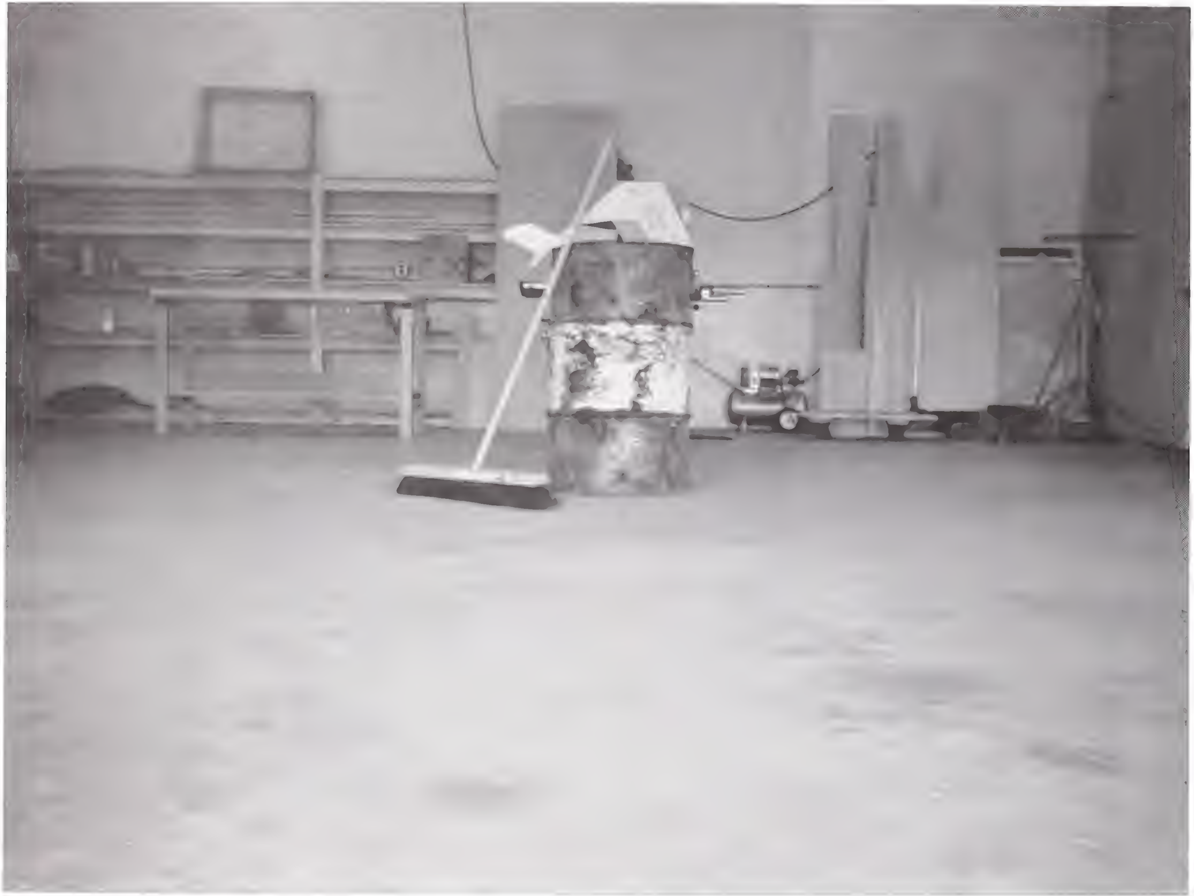


Figure 61. The most important equipment of all

chapter 14. WORKSHOP EQUIPMENT

Abrasive Cut-Off

The abrasive cut-off is used for cutting iron. It should be capable of cutting pipe at least up to 150 mm (6 in.) in diameter and have a vise with angle adjustment of at least 60 degrees. Mounting it on three wheels makes it readily portable. It should have a good shield to protect the operator as well as have a place for most of the grindings to be collected. Eye protection is necessary.

Acetylene Welder

Mount the acetylene welder on a two-wheel cart for portability. The hoses should be at least 15 metres (50 ft) long so that the welder will not have to be moved very often. A tool box mounted on the cart handles is handy for tips, cleaners and other small parts such as soap stone. A hanger should be provided for the torch and for the hose. Safety goggles are necessary so locate them nearby.

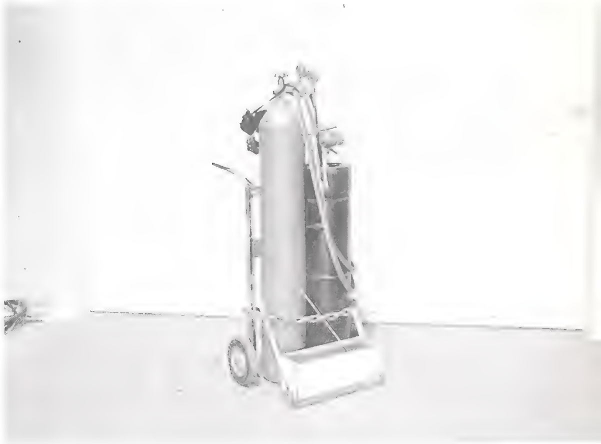
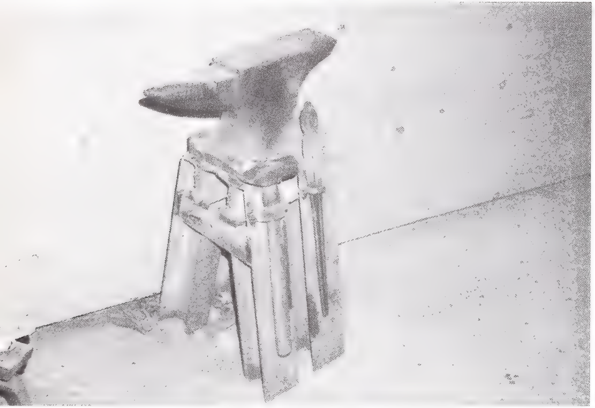


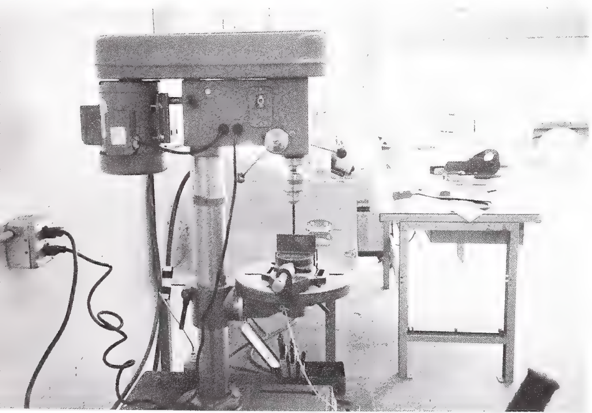
Figure 62. Acetylene welder.

Air Compressor

The air compressor for the large and medium workshops should be equipped with a motor size of 1 to 2 horsepower. For a small workshop smaller units (3/4 hp) are available. Normally the



igure 63. *Shop anvil.*



gure 64. *Drill press.*

receiver tank which comes with the air compressor is adequate. In applications where many air operated tools and devices are used, consideration should be given to a larger receiver. This will ensure an adequate supply of air without having to wait for the air supply to be replenished. A manual over-ride switch is available to enable higher pressures to be achieved for special applications. Air compressors usually come equipped with water and oil traps and drain cocks. Larger air compressors are available in two-cylinder models. They tend to operate more smoothly than single cylinder ones and will likely last longer. The pressure gauge mounted on the air compressor should be oil-filled to provide damping for the needle, otherwise it will break.

The air compressor can be portable or stationary. If stationary, consideration should be given to mounting it on a wall and building an enclosure around it to attenuate the noise. If an enclosure is considered, allow for air intake and cooling.

Anvil

The anvil should weigh at least 50 kilograms (100 pounds). The older types of anvils are more useful than some of the new ones on the market. So watch the auction sales.

The anvil should be located with space all around it and it should be possible to place long pieces on it from at least one side. An anvil without a good stand is next to useless. The stand should be heavier than the anvil but not so heavy that it cannot be moved around its main location.

Cleaning Tank

A cleaning tank should be located near the service area. Initial cleaning of parts just removed from a machine is done here. There will be a lot of grease and mud on parts and so the tank can be expected to accumulate a lot of foreign material. The tank should have a cover to keep out dust and grindings from the welding area.

Since a great deal of mud and grease will have to be removed in this area it would be worth having a flat surface made of a coarse mesh to do a primary cleaning on parts before they are put into the tank.

Drill Press

The drill press should not be located in a corner as this prevents drilling of long pieces. It should be located between the welding area and the machining shop area. It should be possible to move the drill press for special drilling operations.

There should be a light mounted on the drill press so that the point of the drill can be seen for positioning. An adjustable light has advantages but it does tend to move from vibration. The motor may be operated with a foot switch to allow both hands to be free for feeding and holding the pieces. An automatic coolant and lubricant feed should be considered if a lot of use is made of the drill press. Adjustable stands should be provided on either side to support long pieces.

Electric Welder

Locate the electric welder near the door so that welding can also be done on equipment on the apron. Cables are a very good investment. The electrode-holder cable should be about 20 metres (65 ft) long and the ground cable about 12 metres (40 ft) long. A holder should be provided on each side of the welder for each cable. It is strongly recommended that the cables not be coiled up together. There may be occasions when the electric welder may have to be used on equipment located farther away from the shop. In these cases, it would be better to move the welder and have a longer input cable and/or provide additional welder receptacles. Because the current is lower there would be less of a voltage drop on the input cable, than on the secondary side and so the welder would perform better.

If a welder is being purchased consideration should be given to the rectifier-type as this allows one to use AC or DC. The use of DC makes horizontal, vertical and overhead welding easier than AC.

Engine Stand

An engine stand is invaluable for rebuilding engines. It has wheels to make moving the engine easier. The engine can be clamped onto the stand and rotated 360 degrees for working on the top, bottom and sides. A series of adapters will enable a large variety of engines to be mounted on it. The crane above it is used for lifting crankshafts and for attaching a portable honing unit. The fluorescent light above it provides light for detailed work on the engine.

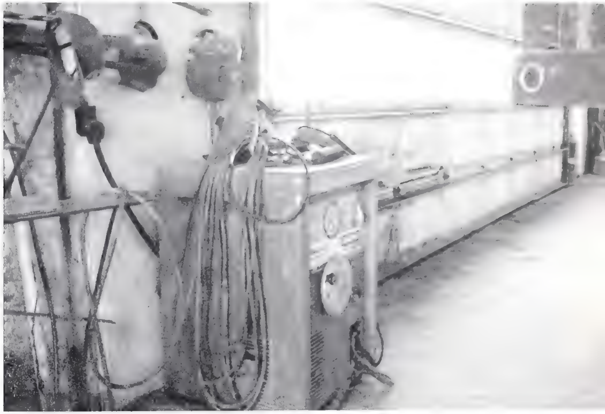
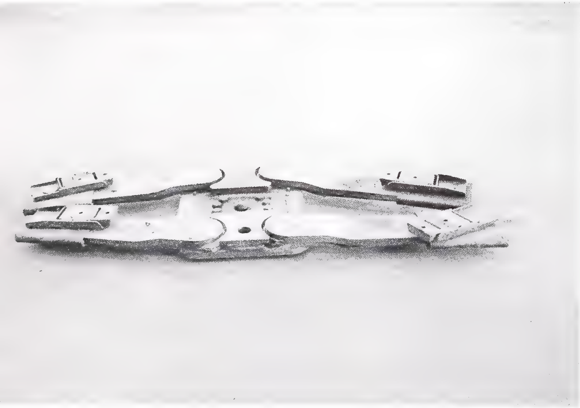


Figure 65. Electric welder.

Figure 66. Portable Crane.



ure 67. *Floor hoist.*

ure 68. *High pressure washer.*

Grinder, Bench

Bench grinders tend to deposit a great deal of grit and grime on the workbench. For this reason a bench grinder should only be used as a tool grinder for sharpening and dressing cutting tools such as drill bits, lathe tools and milling cutters. It has a fine wheel and a medium wheel and they must be kept well dressed at all times. Tool rests should be easily adjustable and may have special angle grooves for grinding certain tools. The lighting must be brighter than around a pedestal grinder. A container of water must be kept handy for cooling tools as they are being sharpened.

Grinder, Pedestal

Pedestal mounted grinders are preferred in the welding area since they can be moved if necessary. The wheels should be at least 400 mm (8 in.) in diameter and 25 mm (1 in.) thick. A relatively coarse grinding wheel and a wire brush wheel make a good combination.

The grinder should have good guards around the wheels to collect the grindings and contain the wheels in the event that they should burst. A tool rest is imperative. It helps to hold the piece and allows the operator to apply steady force against the grinding wheel so the stone wears uniformly. It is a good idea to have tubes leading from the guards to a container to collect grindings and wear from the grinding wheels. This is important since it will prevent abrasive dust and grindings from spreading through the shop.

A container of water should be placed beside the grinder for cooling parts being ground.

High Pressure Washers

High pressure washers have gained popularity in the past few years as farmers realize the benefits of keeping equipment clean. Not only is it easier to service clean equipment but rusting can be prevented if dirt is periodically removed, expecially at the end of the season. A great deal of damage is done to equipment because of prolonged dampness resulting from accumulated dirt which gets wet and requires a long time to dry.

High pressure washers are available in two types — those which heat the water and others which use cold water. It is possible to add detergents and other cleaning agents to aid in cleaning and removing grease. The units which heat the water are usually oil fired but electric ones are available. Electric heaters require a great deal of power and may not be useable on many farms.

Hydraulic Press

The hydraulic press should be located so that long pieces can be inserted from all directions. It is not necessary to bolt it to the floor. Lighting is important especially during installation and removal of bearings and bushings. A table should be located near the press to hold parts before, during the after assembly and disassembly. A foot/hand operated control is very useful. A shield for the operator is advisable as parts do break with a tremendous force.

Lathe

The lathe should be located so that long pieces can be machined. This means leaving space at both ends. Heavy pieces are often brought to the lathe with a portable crane and so space should be allowed for it.

The lathe must be levelled and preferably bolted to the floor. There are a number of very good inserts for setting into the floor and vibration damping pads which should be considered. Follow the manufacturer's recommendations for proper installation. A good, adjustable light is necessary. Mount the light on the saddle to light the area around the cutting tool. A bench near the lathe is recommended for parts to be measured and marked.

Milling Machine

The comments regarding the lathe apply to a milling machine as well.

Vise

A vise mounted on one corner of the welding table is useful. It is very practical to have holes drilled in the table so that the vise can be moved to another location for certain types of work. The vise should have 150 mm (6 in.) jaws and be strong enough to straighten or bend iron. The mass of the welding table will be particularly beneficial for bending or straightening pieces of metal.

Welding Table

A welding table is a very important part of the workshop especially if one builds or repairs equipment. The large flat surface makes it easy to build frames that are square and

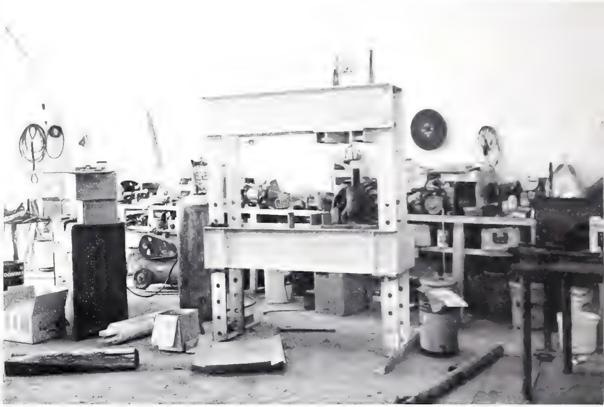


Figure 69. Hydraulic press.

Figure 70. Tool box.

perpendicular. The pieces can be tack-welded to the table to hold them in position before the final welding. One need not be concerned about the welds to the table since they can be easily removed with an angle grinder.

The size of the table top should be 1.2 m by 1.2 m by 25 mm (4 ft x 4 ft and ½ in.) thick. The 25 mm (1 inch) thickness sounds excessive but after some use one will really appreciate the fact that the top can be used as an anvil without vibrations. Pieces of metal can be straightened on it and changing sickle sections is easier. Often pieces of metal are bent or straightened in the vise mounted on the table and the mass of the steel table will prevent it from moving around.

The table should have at least 1.2 metres (4 ft) of clear space on all sides. Placing it against a wall limits your use of one end of the table. It should have receptacles on each of the long sides, and under the top for an angle grinder, electric drill, etc. These should be permanently wired. There should be two shelves under the table top. The one immediately below the top should be divided into compartments to store the angle grinder, electric drill, etc. and their accessories such as spare grinding discs. The second shelf could be left open for storing other items which may be larger. One end of the table can have hooks to hold C-clamps, vise grips.

Worktable With Oil Catcher

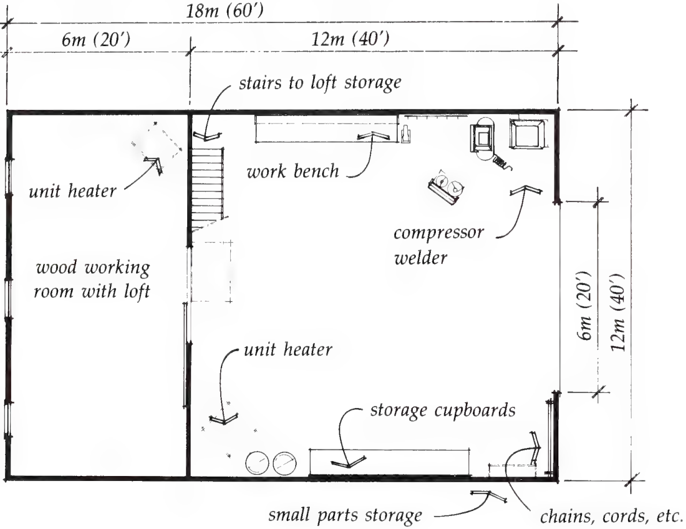
This worktable is used where oil may leak as when disassembling hydraulic pumps and cylinders. The top consists of a rectangular metal top with raised edges which is connected to an oil drain. The edges are raised about 20 mm (3/4 in.) so that oil will not flow off it. The oil will drain away or can be pushed to the drain with a squeegee.

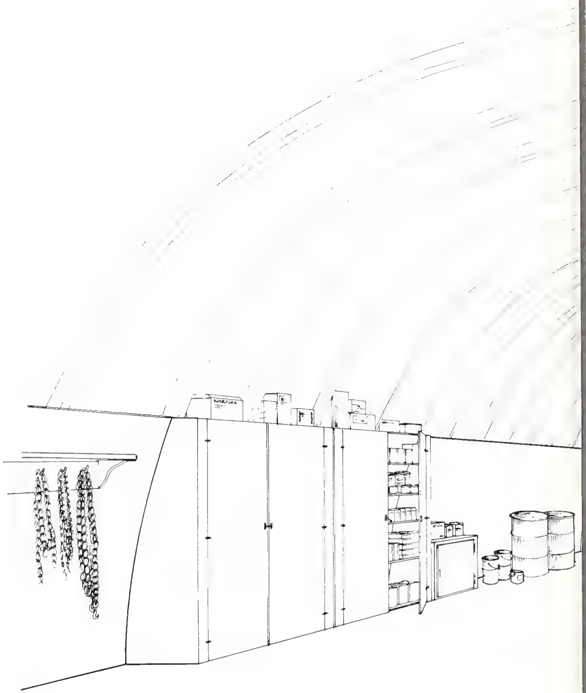
ALBERTA FARM SHOPS

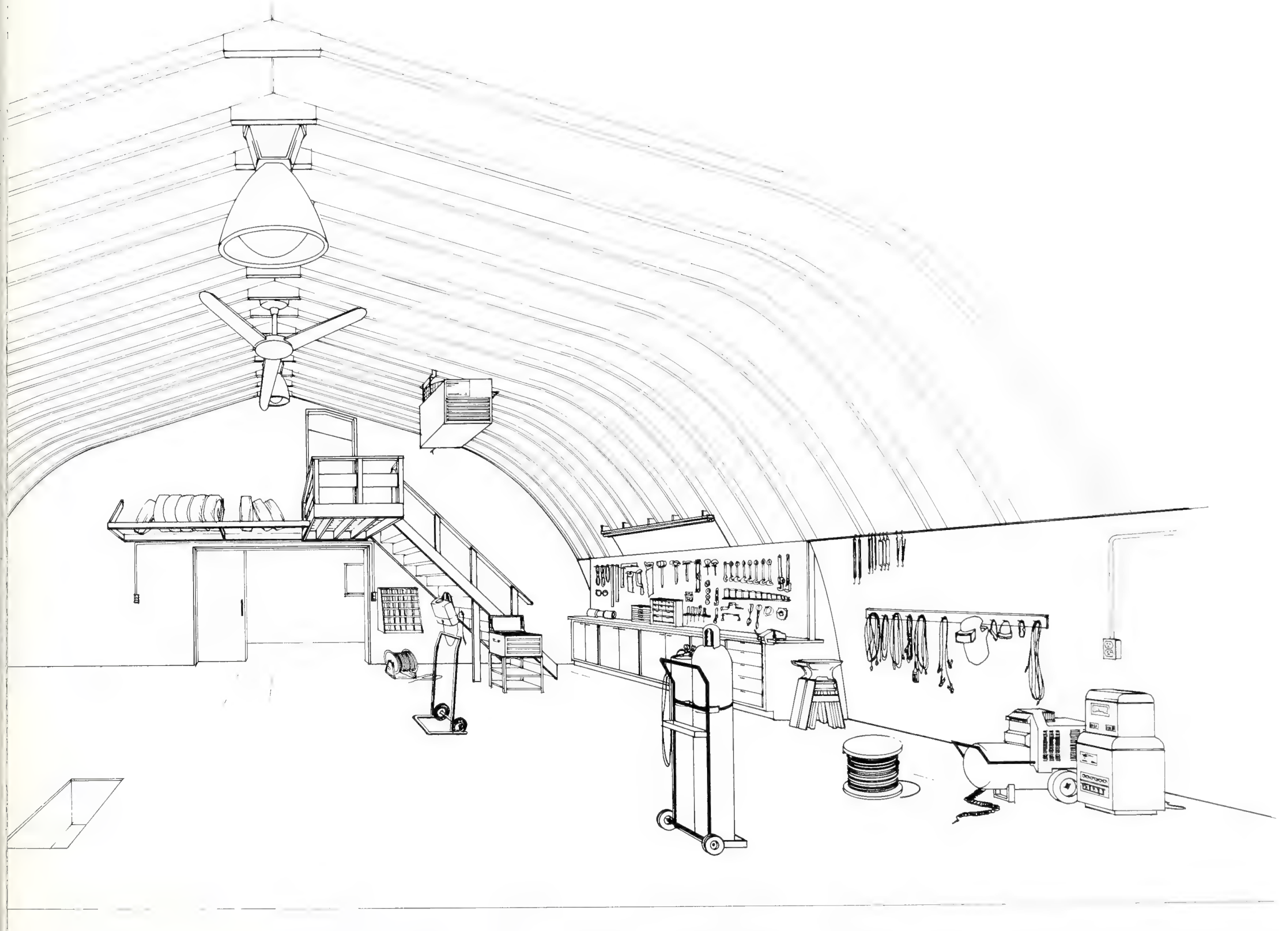
Well Planned Medium Sized Shop

Ir Al Kramer's shop, Fairview Alberta

Although we visited Al Kramer's farm unannounced, it was robably the tidiest workshop we visited. The shop's interior was nished with great attention to detail, which is not the easiest of sks with curved walls. The shop is a 12 metre wide by 18 metre ng (40 ft by 60 ft) archrib building. The front 12 metres by 12 etres (40 ft by 40 ft) section is used as the main farm shop. The ack 6 metres by 12 metres (20 ft by 40 ft) section is completely artitioned off as a heated, insulated woodworking shop, with a orage loft above it. A large set of sliding doors connect the oodworking section with the main shop. Figures 14 and 19 this publication are photos of Al Kramer's farm workshop.



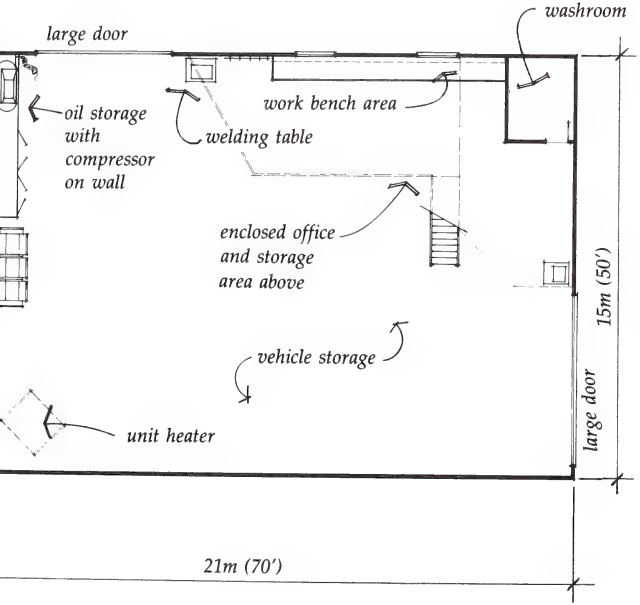


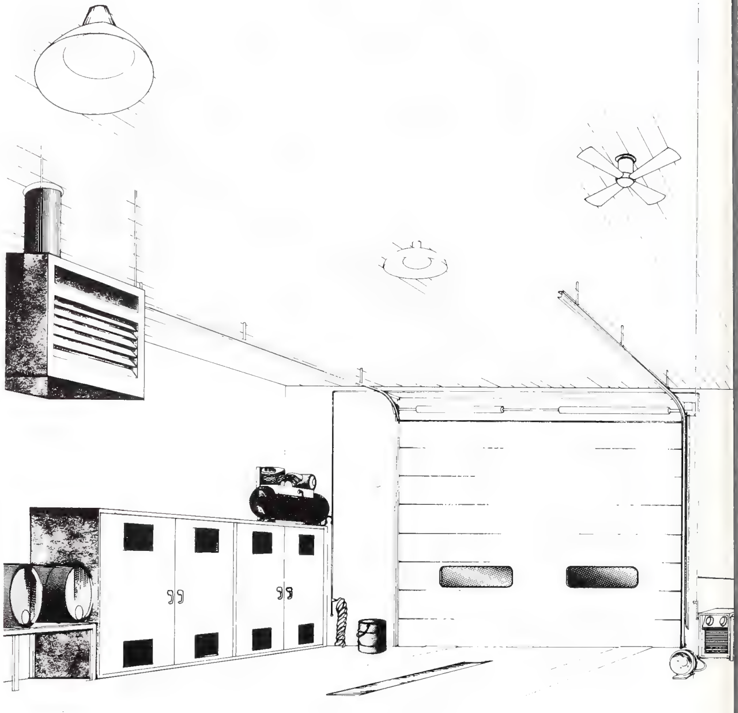


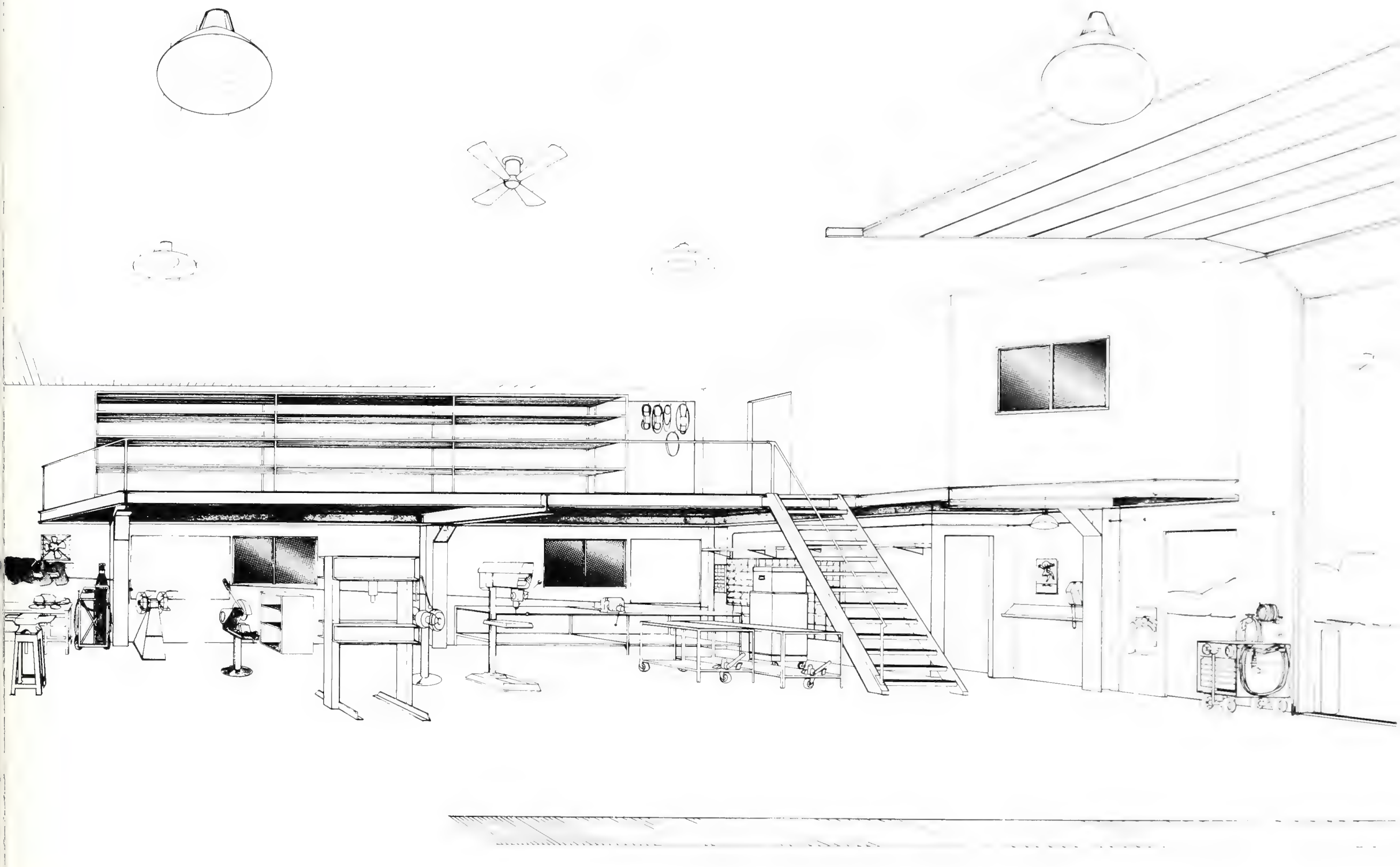
Well Planned Large Farm Workshop

r Cliff Paulgaard's Shop, Hayter Alberta

Cliff Paulgaard's 15 metre wide by 21 metre long (50 ft by 70) shop is so well thought out that several other Provost area farm hops have used a very similar interior layout. This shop has two rge doors, a large, well organized work bench area and a ashroom (by the stairs). Over the bench area is a cantilevered artial second floor with an enclosed shop office and a storage rea with a wrought iron railing. In addition to the unit heater hown in the picture, the bench area was heated by a forced air rnace with ducts in the floor. Figures 5, 8 and 16 in this ublication are photos of Mr. Paulgaard's farm workshop.







APPENDIX

TABLE A. DESIGN HEAT LOSS IN KILOWATTS

BUILDING COMPONENT	FLOOR AREA (square metres)						
	50	100	150	200	250	300	350
FOUNDATION							
uninsulated	2.0	2.8	3.5	4.0	4.5	4.9	5.3
insulated (R5)	1.2	1.7	2.1	2.4	2.7	2.9	3.2
WALLS							
R12	2.8	4.0	4.9	5.7	6.4	7.0	7.5
R20	1.7	2.4	3.0	3.4	3.8	4.2	4.5
CEILING							
R12	1.1	2.2	3.3	4.4	5.5	6.6	7.7
R20	0.7	1.3	2.0	2.6	3.3	4.0	4.6
R32	0.4	0.8	1.2	1.6	2.1	2.5	2.9
R40	0.3	0.7	1.0	1.3	1.6	2.0	2.3
AIR LEAKAGE							
large door rarely opened	3.5	7.0	10.5	14.1	17.6	21.4	24.6
large door often opened	6.4	12.9	19.3	25.8	32.2	38.1	43.9

Based on: a temperature difference of 50℃ and a 4.2 metre ceiling height.

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Farm Workshops